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THE

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THE STEAM TURBINE *v.* THE SMALL HIGH-SPEED ENGINE.

IT is perhaps only natural that the introduction or invention of anything new, however valuable in itself, should be accompanied by the drawback that a fashion is liable to be set for it—a fashion which tends to disregard principles, and to bring discredit on the invention by false application.

Central station practice in this country cannot claim to be free from this trait of human nature, and in many cases fashion plays a greater part in the every-day actions of those moulding practice than they would care to confess.

The steam turbine has not escaped this fashion. It is true that in the larger sizes of unit it has amply justified the claims of its supporters on the grounds of first cost, economy and simplicity, and this in spite of somewhat extravagant demands for additional power which has to be expended in the auxiliary plant. There seems, however, no *immediate* prospect of its being able to justify its supporters in the smaller sizes of unit, and it is this side of the question which deserves attention. The majority of our leading engineers who are installing steam turbines in the larger sizes would not be likely to do so in the smaller sizes, unless for some very special local reason; but the remark does not apply with equal force to many others, especially those engaged outside central station practice, who seem in some cases to be led away with the idea that turbines are replacing reciprocating engines under all conditions, and are taking steps which they may regret—or perhaps more correctly, their employers may regret—later on.

The whole thing turns, of course, on where the line should be drawn between turbines and reciprocating engines. Although there is necessarily much difference of opinion upon this point, the general view held by those whose opinions deserve attention, fixes a limit at 500 KW. as the smallest size advisable—or permissible, so far as merits are concerned—for a turbine. Where it is a continuous-current dynamo that has to be driven, the line will in most cases be drawn rather higher. There can be little doubt but that this opinion is based on commercial grounds.

In the smaller sizes turbine sets offer no inducement on the question of first cost, especially where allowance is made, as it should be, for the larger size of condenser required for giving the extra vacuum.

On the question of simplicity and attendance in running, the performance of a good reciprocating engine of, say, 500 KW., leaves little to be desired, and it is difficult to conceive of any other type of prime mover which will cost less, or be a source of less anxiety in the engine room.

Finally, on the question of economy the steam turbine has difficulty in approaching in these smaller sizes the economic results possible with the best forms of reciprocating engine,

and this in spite of considerable additional power being expended in maintaining the most favourable conditions in the form of high vacua, conditions which are a charge of some weight on stations dealing with an average load factor, and which the reciprocating engine plant does not require.

When this additional charge is taken into account, it leaves the small turbine sets considerably behind the reciprocating engine sets.

There were published in our issue of November 18th last the results of some steam consumption trials recently carried out by the Cork Electric Tramway Co. (under the supervision of their consulting engineer, Mr. C. H. Merz) on a 500-KW. turbine of the Curtis type—the first of its kind installed on this side of the Atlantic.

It would, perhaps, scarcely be fair to compare the figures obtained in this isolated case with the more numerous tests carried out on horizontal turbines, and we would prefer deferring judgement on the economic results of this type of prime mover until further results are available, spread over a wider sphere; yet the figures are of interest in reminding us that the results obtainable with turbines of these smaller sizes, are not what some would have us believe.

At full load, with a steam pressure of approximately 150 lbs., with 100° F. of superheat, and with a vacuum of 26·9 in., the steam consumption obtained at Cork was 20·6 lbs. per KW.-hour, and the best reliable results that have hitherto been obtained with horizontal turbines of the same size, and under somewhat similar conditions, can be put at about 19 lbs. of steam per KW.-hour.

It will be within the recollection of those interested in these matters, that in our issue of September 9th were published the results of some steam consumption tests obtained with reciprocating engines at Blackburn and at Poplar, the former on a 750-KW. set, and the latter on a 500-KW. set. Taking the latter tests for purposes of comparison with the results obtained at Cork—the output in both cases being similar—we find that the Willans engines at Poplar, with a somewhat higher steam pressure than prevailed at Cork (viz., 180 lbs. against 153 lbs.), but with a very much smaller degree of superheat (viz., 25° F. against 104° F. at Cork), and with a more usual vacuum (viz., 25 in. against 26·7 in. at Cork), gave a steam consumption of 18·64 and 19·52 lbs. of steam per KW.-hour—against 20·6 lbs of steam per KW.-hour obtained at Cork.

If the results usually promised for turbines in these smaller sizes were obtained with the same expenditure of power in condensing, one might be inclined to say there was little to choose between the two forms of prime mover, so far as economic performance was concerned. This, however, is not the case, and considerable additional power has to be expended to enable the turbines to give the results they do give. Hence it is that for sizes below 500 KW., the advantage is in favour of the reciprocating engine, in spite of the greater cost of buildings, foundations, &c., required for the latter.

It would be unreasonable to argue—seeing what progress has been made in improving the steam turbine during recent years—that further improvements will not be brought about to justify the installation of the smaller sizes, but, for the present, it is sufficient to say that the reciprocating engine, in the smaller sizes, still holds its ground.

Engine Balancing.

CONSIDERABLE trouble is constantly being reported in connection with lack of balance in steam engines. There is nothing in engine balance that cannot be accurately determined by a good mathematician, and vibration troubles may be considered as due to neglect of some of the forces which cause it. Thus it was usual years ago entirely to overlook the effect of the slide valves, but, with high speed engines, the valve assumes a position of much greater importance, and, moreover, in many high speed engines, the valve and its appurtenances are of much greater weight relative to the other moving parts than was once customary. Mr. S. A. Moss, in his recent paper before the American Society of Mechanical Engineers, states that the effect of the connecting rod may be almost exactly calculated by assuming a certain fraction of its weight concentrated at the crank pin. There is very little guide pressure due to inertia effects of the rod.

The fraction of the rods weight to be counterbalanced by a weight opposite the crank pin is $k^2 \div l^2$, where k is the radius of gyration of the rod about axis through cross-head pin, and l is the c to c length of the rod. Then, if w = total weight of the rod, the fraction $w\,k^2/l^2$ is the equivalent weight at the crank pin, and in the absence of actual knowledge this fraction may be assumed very closely as $\frac{1}{2}$. Similarly for inertia effects, the fraction of the rod which gives purely rectilinear effect is $1 - k^2/l^2$, or, again, in the absence of actual value one-half. If the rotating weights alone are counter-balanced, there will be no effect in the direction of shaking the engine bed. The inertia effect is very usually partly balanced at the expense of introducing a shaking axis perpendicular to the axis of the engine. It is incorrect to assume the whole connecting rod as reciprocating, as is often done.

The paper does not go very fully into the question of balance, for it is certain that for high rotative speeds an approximate balance cannot be obtained without bob weights, unless two engines are coupled on the same crank pin, the axes of the engines being at 90°, or by a suitable design of three cranks. Engine balance has been rather made to suffer by the fashion of having cranks at angles instead of opposite. If the opposite position can be employed, a three-crank engine can be very well balanced, but in careful work the valves and gear should be fully considered.

The Electrical Reduction of Cinnabar.—In H. Becker's new process for obtaining metallic mercury by heating its sulphide, or cinnabar, in the electric furnace, various defects which accompanied the older methods of winning this substance are said to be overcome. The furnace is placed under a hood, through which a constant current of air is made to ascend, and the ends of the electrodes, which project outside the furnace, are placed within closed tubes, through which the electrical connections pass, in order that vapours may not escape from the apparatus. The mercury distils off through a sharply descending iron tube, rectangular in section, a wider tube of similar figure surrounding it, cold water being caused to circulate in the space between the two. The end of the condenser dips below water, and provision is made for any vapour still remaining to enter a large chamber for perfect condensation. The charge consists of cinnabar and twice as much lime as there is mercury in the ore. If the mineral is pyritic, a larger proportion of chalk is employed. If the amount of chalk employed is too small, the vapours of metallic mercury are accompanied by those of the sulphide, and if the cinnabar is heated alone, it distils as such. Low-grade ores can be treated similarly—preferably, perhaps, after a preliminary concentration.

Production of Ammonia and Caustic Alkali.—A Swedish patent has been taken out by G. E. Cassel, of Stockholm, for a process of manufacturing ammonia from the atmosphere, and obtaining a caustic alkali simultaneously. The compounds of nitrogen and oxygen which are produced by the action of an electric discharge on air are absorbed in lime or calcium carbonate. Calcium nitrate or nitrite is thus obtained, and is converted into the corresponding alkali compound by means of an alkali metal salt. The alkali nitrate or nitrite is then electrolysed with insoluble electrodes, in presence, if necessary, of a little lead salt. Gaseous ammonia is evolved and recovered in any suitable way, while the liquid contains caustic alkali.

THE SPINDLERSFELD SINGLE-PHASE ELECTRIC RAILWAY.

(*Concluded from page* 973.)

Where the trolley line passes under a bridge, great precautions have to be taken on account of the high pressure of the working conductor; the method adopted on the Spindlersfeld line is illustrated in fig. 9, which shows the 6,000-volt trolley wire passing under a steel girder road bridge. It will be seen that the trolley wire is supported from a wooden troughing by means of heavy insulators mounted

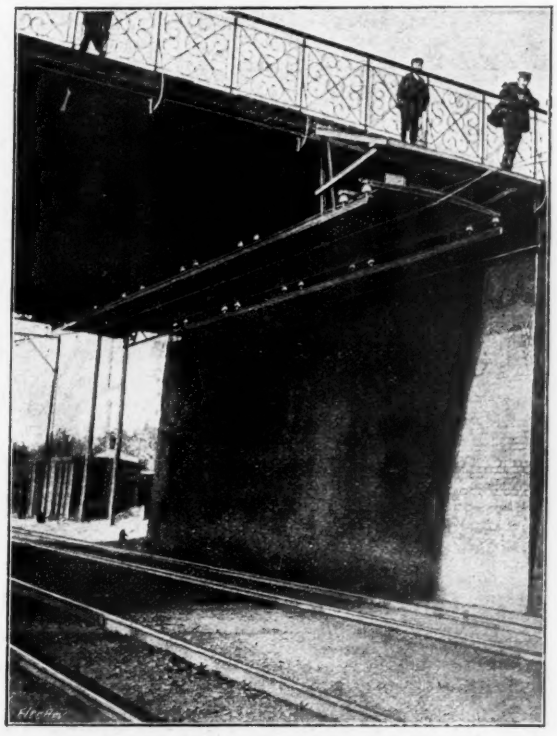


Fig. 9.—Protection of High-Tension Trolley Wire under Iron Bridge.

upon a wooden frame work. Great care must, of course, be taken in such situations to make the mechanical connections in such a way that no danger to the public could result from a high-tension wire touching the steel girders.

Descriptions of the single-phase motor and controlling devices with which this line is equipped, have appeared before now in the technical Press, but it may not be amiss to add a few words of description to the present article. The motor, which may be regarded as the most important item of the equipment, consists of a rotor or revolving armature and fixed stator or field magnets. The winding of the stator is similar in form to that of ordinary induction motors and generators; there are no salient poles, and the field winding is laid in slots. The rotor has a commutator and two pairs of brushes which are electrically 90° apart. The first pair of brushes coincide with the axis of the magnetic field, and are short-circuited. The second set are electrically 90° from the former, and are called exciting brushes. They are connected to the secondary of a transformer, the primary of which is in series with the high-tension stator or field winding. The voltage of the exciting current can be regulated by varying the number of coils connected as shown on the diagram, fig. 10—in other words, by varying the transforming ratio. The use of this transformer enables a very high pressure to be used in the fields, whilst a low pressure can be used in the armature winding, and hence obviates the difficulties which would arise if a high pressure in the fields necessitated the same pressure in the armature, as is the case with the series-wound alternating-current motor.

The current which flows in the armature sets up a magnetic field at right angles to the magnetic field produced by the stator or field winding. As the current supplied is alternating, a transformer action takes place between the field and the armature winding. The field produces an E.M.F. in the armature winding which causes a current to flow through the short-circuited pair of brushes on the commutator. This current, in combination with that produced by the armature revolving in the magnetic field, causes a torque in the same direction as that due to the latter, the value of the torque

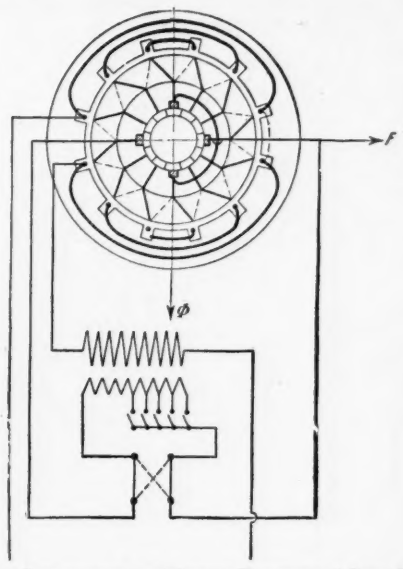


Fig. 10.—Connections of Winter-Eichberg 2-Pole Motor.

varying with the field strength and the current in the armature. When the armature is in motion, its conductors cut the magnetic field, and an E.M.F. is generated which decreases the effective E.M.F. in the secondary or armature winding. Thus, as the speed increases, the secondary current decreases, and the torque is reduced. An additional torque is obtained at an increased speed by increasing the E.M.F. of the armature excitation.

The reversal of the direction of running is obtained exactly as in a direct-current series-wound motor, by reversing the direction of the current either in armature or field, and this is obtained by reversing the switch on the secondary of the transformer which excites the armature. This motor therefore acts in a very similar manner to the ordinary direct-current traction motor, but with the added effect due to the transformer action which takes place between the field and the armature.

The connections of the motor are shown diagrammatically in fig. 10. As will be seen, the high tension current, at a pressure of 6,000 volts in this case, passes through the primary of a transformer into the field or stator of the motor, and from there returns by the track rails; the secondary of the transformer is connected to two brushes resting on the commutator of the armature or rotor of the motor, which are electrically at 90° to the axis of the principal magnetic field, which is produced by the stator. The armature is wound in very much the same way as an ordinary continuous current series traction motor, except that the voltage between the commutator segments is kept very low, and thus a larger number of commutator segments are needed than in an ordinary continuous current motor. The commutator is short-circuited by a pair of brushes on the axis of the main field.

The secondary of the transformer has five connections, by which the ratio which exists between the primary and the secondary windings can be varied. By this means the voltage of the compensating or armature exciting current can be varied.

The effect of increasing the pressure of the armature-exciting current is to shift the speed, torque, efficiency and power factor curves. For a given ratio of transformation a certain torque, which corresponds to the greatest efficiency of the motor, will be reached at a given speed of the armature. If the ratio of transformation is decreased, that is to

say, if the armature exciting voltage is increased, the same torque and efficiency will be reached at a greater speed. In other words, the arrangement enables a nearly constant torque to be obtained with high efficiency and high power factor at five different speeds. The result of this is, that more favourable acceleration curves are obtained than could be got with direct-current traction motors. Thus, with a direct-current motor the acceleration, which is very large at starting, rapidly decreases as the speed of the car increases, and therefore, in order to obtain an average acceleration of, say, 1½ ft. per second per second during the whole period, it is necessary at the very commencement to reach an acceleration which may be as high as 4 ft. per second per second, and this calls for a correspondingly large starting current. In a U.E.G. single-phase motor, the acceleration can be kept very nearly constant during the whole period of acceleration, and therefore the very large starting current necessary with direct-current motors will not be required. The motors have an air-gap of 3 mm.: the weight of each motor, including the pinion, is 2,140 kg., and the weight of the transformer required for two motors is 1,100 kg.

Characteristic curves of this motor giving the speed, tractive effort, efficiency and power factor are reproduced below (fig. 11). Each of the curves is numbered, the

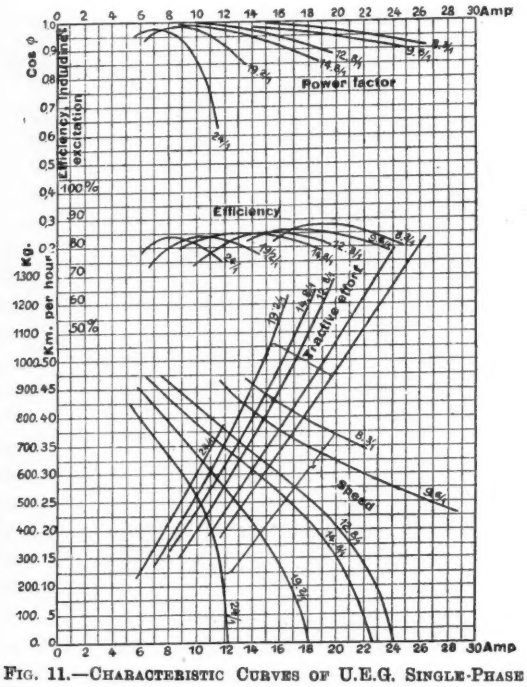


Fig. 11.—Characteristic Curves of U.E.G. Single-Phase Motor.

number corresponding to a given position of the secondary transformer switch, that is to say, a given excitation E.M.F. It will be seen that although, for a short time at starting, the power factor is very low, yet even this power factor is higher than that obtained in practice on the Valtellina line, and is at least as good as what is regularly expected at present where direct current is used in connection with rotary converters. Fig. 12 shows the motor.

When the motors are stopped the secondary circuit of the transformer is opened. The primary then acts as a choking coil, so that very little or no energy is wasted in the stator of the motor, and for this reason it is not necessary to open the high tension circuit in ordinary running; if trains have to stop a long time, the high tension circuit can be opened by means of a special switch. At starting no energy has to be wasted in resistances, as is the case with direct-current motors and resistances. The wattless current at starting causes the power factor to be low, but only for a very short period; it rises rapidly as the speed increases, and can be arranged so that at between 10 and 15 miles an hour the power factor is above ·7, and, in fact, in making calculations for a complete system with a large number of trains operating it will probably be found that the average power factor for the whole system will be between ·8 and ·9, or quite as good as the power factor obtained where rotary converters are used, as, for example, on the Central London and Lancashire & Yorkshire Railways. The controller methods used are illustrated in fig. 13, which shows the controller connections. The controller is similar in appearance and construction to

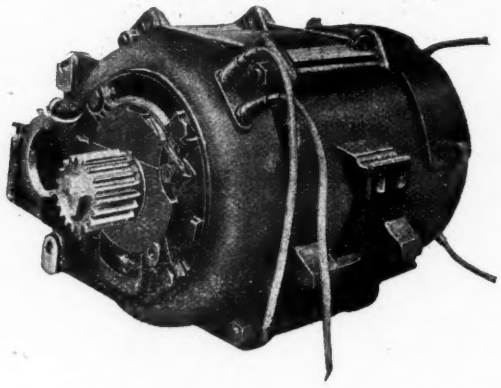


Fig. 12.—Winter-Eichberg Motor as used at Spindlersfeld.

the master controller used in the multiple unit system of the G.E. Co., of America, where direct currents are used, and to the system adopted on the Central London, the Great Northern and City, and the North-Eastern Railways. A separate controller is supplied for reversing. The magnetic switches are attached to the side of the car, where they are easily accessible, and they are operated by low tension current supplied from a special small auxiliary transformer, which supplies current for lighting the cars as well as for operating the motor-driven air compressor operating the brakes. A resistance is put on the cars, but is only used to short-circuit the armatures of the motors when braking; and when this connection is made through the controller, the motors act exactly as continuous-current motors do. Before the car can be started the reversing switch has to be in the forward position, and the high-tension circuit breaker must be closed. Current is then supplied to the electro-magnets which operate the switch controller, and the handle can then be moved

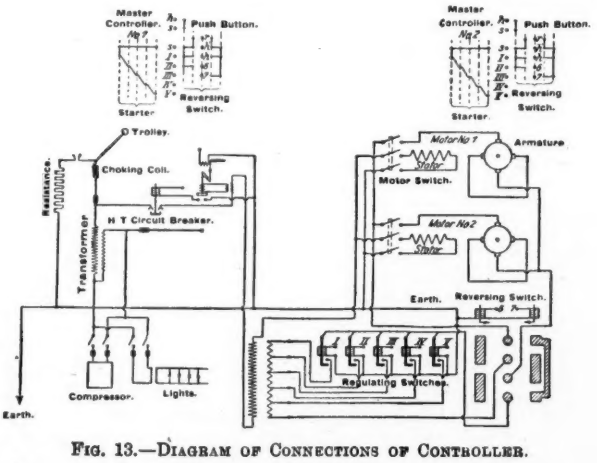


Fig. 13.—Diagram of Connections of Controller.

and the various switches, I to V, closed as required (see fig. 13). The handle of the master controller is supplied with a button which has always to be kept pressed down by the driver; should he let go this handle, two things will happen—first, the current will be cut off from the electro-magnetic switches by the rising up of the button, and, therefore, the secondary circuit of the transformer will be opened and the motor brought to a standstill; secondly, the controller handle will go back to the off position, and will also put on the Westinghouse air-brakes. Therefore any accident to the driver will cause the immediate stoppage of the train. Should the driver

release his handle or take his thumb off the button whilst running, it will be necessary for him to start again from the beginning, and therefore no damage will be done to the motor.

The trolley is raised to and lowered from the wire by means of compressed air. The high-tension circuit-breakers and wiring are entirely enclosed in fire-proof casing, which can only be got at when the trolley is down, as the door is locked when the trolley is up, and cannot be opened until the trolley is down, and this is immediately connected to earth, so that even should some accident happen to the high-tension wire connected with the trolley, no damage can be done by handling the high-tension conductors, as they are earthed. The current and the voltage dealt with by the master and reversing controllers are all very small, and no high-tension current can by any means be got at, either by the drivers, conductors or passengers.

The U.E.G. single-phase system has been adopted on the line between Nieder-Schönweide and Spindlersfeld. The first experimental running on this line was in August, 1903. The train is composed of two motor-cars with three trailers in between, each of the trail cars weighing 16 tons. The maximum speed of this train is supposed to be 40 km. an hour, although the service is also run at a speed of 60 km. With nearly 30 per cent. voltage drop, it is possible to operate at 40 km. an hour, and when the voltage drop is 60 per cent. it is possible to run up to 30 km. an hour; and the whole train has been operated with only two motors. The motor-cars on this line weigh 51,660 kg. (nearly 51 tons), and are mounted on two six-wheel bogies. These cars are unnecessarily heavy, and the only reason for using them was that the German State Railways were doubtful whether the system could operate a standard heavy main-line passenger coach, which possibility has now been demonstrated. The weight of the electrical equipment is about 6 tons, which is included in the weight of the motor-car given above. Each motor-car is equipped with two motors, rated at 100 H.P. each, and fitted on one of the bogies with single reduction gearing, the ratio of which is 1 to 4·26. The diameter of the wheels is 1 metre. Besides the ordinary hand-brakes, Westinghouse brakes are fitted, and compressed air is supplied by an automatically controlled air compressor.

The average distance between stops on this line is 200 m. (·124 mile), and the average acceleration is ·4 to ·5 m. per second per second (16 to 20 in. per second per second, or 0·9 to 1·1 miles per hour per second). The motors on these cars weigh from 15 to 20 per cent. more than the equivalent continuous motors.

DESIGN OF ALTERNATORS.

By A. PRESS.

UNDER the heading "Design of Dynamos,"* the writer suggested that the minimum copper loss condition should be made the basis for the ratio of $\frac{D}{l}$ in terms of p for direct current generators. Thus, in the case of induction motors,† the suggestion was made that the value of σ for a given $D^2 l$ should determine the value of $\frac{D}{l}$. With direct current apparatus, the sparking condition which depends fundamentally upon the value of the self-induction of an armature ampere-turn does not enter very seriously into the design. Cases, of course, may and do arise due to exacting conditions, when the self-induction becomes of importance. The problem then resolves itself into one analogous to the alternator problem.

With a given open-circuit characteristic, it is easily seen that the reactive drop will be smaller, and hence the regulation will be better the smaller the self-induction of the armature. Since the regulation in an alternator is so all-important, the value of $\frac{D}{l}$ in terms of p, with a view as to the self-induction, should be made the basis for alternator dimensions. Different systems of windings give rather different values for the inductance, even though the same alternator carcase be employed. In the following, the length of the end connections will be assumed the same as is usually the case with direct current windings. A formula for the self-induction per centimetre ampere of embedded conductor in open-type slots is the following:—

$$L = \frac{\cdot 38\ (\rho + 6)}{\sqrt{\text{slots per pole and phase}}}. \qquad (1)$$

Assuming that the coils span a pole-pitch, and that the self-induction per centimetre ampere of free conductor is 2, the self-induction per armature ampere-turn can be represented by

$$2\,l\,L + \frac{8\,\pi\,D}{\sqrt{3}\,p}. \qquad (2)$$

Allowing that $K = D^2 l$, a constant, and investigating for $\frac{d}{d\,D} = 0$, the total self-induction will be least when

$$\frac{d}{d\,D}\left(\frac{2\,K\,L}{D^2} + \frac{8\,\pi\,D}{\sqrt{3}\,p}\right) = 0,$$

or

$$\frac{D}{l} = \frac{\cdot 105\ (\rho + 6)}{\sqrt{\text{slots per pole and phase}}}\,.\,p. \qquad (3)$$

Taking the value of ρ as equal to 3, and noting that the number of slots per pole and phase varies from 2 to 6, it is seen that as limits

$$\frac{D}{l} = (\cdot 385 \text{ to } \cdot 67)\,p. \qquad (4)$$

In practice in many cases for each diameter certain numbers of poles only are stocked and the limits assigned to the value of ε, the factor of p, are about ·2 to 1. The heating conditions still permit of the same form of output equation, and for alternators the following empirical formula can be employed—

$$D^2\,l \text{ revs. (cm.}^3) = 72\ (1\cdot 5 + \sqrt{K\,V\,A})^2 \times 10^4. \qquad (5)$$

Thus the $D^2 l$ revs. for alternators is twice that which obtains for direct current dynamos for the same effective output. The efficiency can be expressed in the same manner as in the paper on induction motors above cited. One has—

$$\eta_{A.C.} = 100 - 4\cdot 5\left(\frac{3\cdot 5}{\sqrt{K\,V\,A}} + 1\right)^2. \qquad (6)$$

The efficiency for a given output is about the same as for direct current.

By some easy steps in transformation the price equation can be reduced to the form—

$$\text{Cost} = a\,\frac{(\varepsilon\,c)^{\frac{2x-2y}{3}}}{R^{\frac{2x-y}{3}}}\cdot\left(\frac{W}{s}\right)^{\frac{x+y}{3}}. \qquad (7)$$

Here c = frequency; R = revs. per minute; W = output; s = "design coefficient"; and a is a constant.

It will be observed that, keeping the cost the same and only varying ε and R, increasing ε from ·2 to 1 permits of increasing R about 40 per cent.

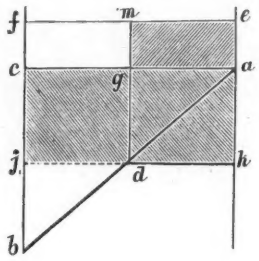
This should prove useful to the designer. Increasing R, however, or diminishing R from a certain critical value depending on the winding, will affect regulation by affecting the self-induction.

In the former articles the value of $\frac{B}{H}$ was expressed in terms of the dimensions of slots. It may be advisable to enter into this matter in rather fuller detail. In the differentiation that led up to the formula for $\frac{B}{H}$, it will be observed that the quantity r was the only variable taken. This is practically taking for granted the magnitude of the values of $B\,n\,\rho\,\delta$. The value δ as a function of D has been given at various times by various authors. For the value of n, or rather $\frac{\pi D}{n}$, one may adopt the following—

$$Z = \frac{\pi D}{n} = 2 + \frac{D}{100}\ (\text{cm.}). \qquad (8)$$

* See ELECTRICAL REVIEW, September 16th, 1904.
† See ELECTRICAL REVIEW, October 14th, 1904.

The value of ρ varies from about 2·5 to 3·5, or one has a mean value of 3. This leads to the following graphical representation :—



The distance $e\ a$ is the value δ, and $a\ c$ equals the tooth pitch $= \frac{\pi D}{n}$, and represents the top of the tooth and slot. The line $a\ b$ is the slot ratio line, and is so chosen that any point, d, being taken, $\frac{g\ d}{d\ h} = \rho$. The tooth is represented by $c\ g\ d$ and the slot by $g\ d\ h$. From the value of B assumed (which is the same for alternators as for D.C. generators, providing the frequency is the same) the value of μ is known. Then for minimum excitation loss, the value μ', indicated by the slot, should agree with value μ, chosen with relation to the frequency of the machine. The value for B, with normal frequencies, can be determined by the equation—

$$B = 25{,}500 - 125\ c. \qquad (9)$$

The symbol, c, stands for the frequency per second.

If the value derived from the slot shape and determined by the point d is consistent with minimum excitation loss, there is a great probability that a different point, d', will be necessary to fulfil the condition of minimum iron and copper loss. The true shape of the slot will, therefore, depend on some point between d and d'.

With the proviso that $\frac{dk_1}{dr}$ be taken equal to zero, the value μ', determined by the slots, is the area $c\ g\ a\ h\ d\ j$ divided by the area $m\ e\ a\ g$. As stated in a previous article, the degree of overhang has no influence upon the slot determination of the permeability.

FAULT LOCALISING INSTRUMENTS.

By TRUBIE MOORE.

The potentiometer principle, as embodied in Murray's and Varley's loop tests, has long been a favourite among mains engineers; but the apparatus used to make the tests has for the most part been of the crudest nature, consisting generally of a few feet of wire stretched on a rough wooden frame, contact being made by the loose end of a lead from the galvanometer. The disadvantages of this rough arrangement are obvious :—

(*a*) Difficulty in measuring the exact point at which balance is obtained.

(*b*) Variation in the sectional area of the wire, due to inequalities in the drawing process.

(*c*) Difficulty in making an even contact with the wire, and finally—

(*d*) The bulky nature of the wooden frame, hence the difficulty of transport without damaging the working wire.

The instrument here described has been designed with a view to overcoming these disadvantages. The first and simplest form is intended for a testing voltage across the loop of about 12 volts, and has a resistance of about 15 ohms.

In this instrument there is a working wire of platinoid of 1 metre length, and of about 1·5 ohms resistance. This wire is stretched on a metre rule arranged for a suitable contact maker to slide thereon. In conjunction with this wire there are 18 non-inductive resistance coils, each of exactly the same resistance as the working wire, which are connected up between the contacts of selector switches and in series with the working wire in such a manner that whatever the position of the selector switches, there are always nine coils and the working wire in series between the terminals of the instrument, and the working wire may be made to take any position in the sequence of the coils, thus giving the equivalent of a working wire 10 metres in length.

It will, therefore, be seen that from the positions of the selector switches and of the contact on the working wire, the point at which balance is obtained can be immediately read off; thus if the switch is at 7 and the contact at 569 on the working wire, the position of the fault is at 0·7569 of the length of the loop, measuring from terminal A. It will be found possible to make a test very rapidly and accurately after a little practice, and I have found the instrument very convenient in actual working.

For use in localising the position of very high resistance faults, I have devised another instrument which allows a terminal pressure of 200 volts to be employed, thus permitting the use of a D.C. generator to supply the test current, and of a Weston millivoltmeter for balancing. This high voltage instrument occupies a space of about 16 in. × 16 in. × 16 in. high.

The design of these instruments has been protected, and patents are pending.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Nernst Lamps.

We can thoroughly endorse the saving that is effected by the use of Nernst lamps if properly adjusted to the working conditions, and have little doubt that the offer made in your issue of 16th inst. to prove this result would be successful.

We also agree with the letter by "S. W. W." as to the advisability of ignoring the reputed voltage and studying the actual conditions. The Nernst lamp, as is well known, consists of a rod of refractory material, which decreases in resistance very rapidly when the temperature is augmented by the smallest increase of current, and in series with this is a compensating resistance which has the opposite property.

Manifestly any voltage absorbed in the series resistance is so much loss, but, equally on the other hand, the more the series resistance the less will be the variation of current with a given alteration of voltage.

Hence it is evident that no fixed combination can be right for all conditions, and the best results as to life and maintenance of candle-power can only be obtained by varying not only the resistance, but the normal working temperature of the rod to suit each case.

The lamps for the English market are all made in Germany at the same works, and have been standardised according to data, which doubtless give the best results in Germany.

The prices in England are the same from whatever source they are obtained, but as one of the limited number of licensees authorised to supply these lamps to the trade in England, we have from the first varied the component parts according to our own experience, to which alone we can attribute the reports we have received that the Nernst lamps we supply are better than others obtained elsewhere.

For **Drake & Gorham, Ltd.**
R. W. S.

Westminster, *December 16th*, 1904.

I heartily endorse the remark of "R. A. P." in your issue of 9th inst. that the new type of burner is a fatal mistake. I take it that he refers to the new type of ½-ampere, and

not to the Luna, which both in the ½-ampere and 1-ampere sizes I have found to be fairly satisfactory, though somewhat erratic, and not as dependable as the old "A" type.

With the old type of ¼-ampere burner with the circular spiral heating coil I have obtained excellent results, a few of them having reached a life of close on 3,000 hours, and a great many over 1,000 hours, very few indeed "dying in infancy." But with the new type of burner quite the reverse is the case, the majority failing in less than 100 hours, or even burning out almost immediately.

I am convinced that if the makers persist in the manufacture of this type they will very soon have no market for their wares.

The principal causes of failure in the case of this particular type of burner are:—

1. The filament shorts on to the heating coil at the top of the bend.

2. The heating coil being rigidly fixed at the base is unable to expand and contract, and very soon breaks away from the porcelain.

3. The filament having a tendency to crystallise under the action of the current, changes its shape in so doing, but, being rigidly held at both ends in this type of burner, this tendency is checked, with the result that the filament breaks, the fracture taking place almost invariably at the centre.

Henry Joseph.

Hythe, *December 17th*, 1904.

In reply to the A.E.G. English Manufacturing Co.'s remarks in your last issue, I think they can safely make their challenge for so short a period as *three months*. I could do this myself, but it is upon jobs that have had over two years' maintenance that I have based my remarks. I will take, for example, one job which caused quite a "furore" when it was done in 1902. At that time 28 burners (0·25 ampere) had an average life of 403·846 hours, and gave great satisfaction, but now the makers can only supply the new pattern with the **U** filament, we can get no such satisfactory results. The lamps, I may say, hang at an angle of 45° (about), and considerable difficulty arises through the filament short-circuiting to the heating coil.

I note that their test job must be where the voltage is 200 or above. Why?

I regret that my letter has been met in so combative a spirit. My object, when joining in this correspondence, was not to provoke a challenge from the makers, but to obtain the opinion of other contractors, with the primary idea of extracting from their experiences information that might be of assistance to myself. May I also confess that, in my conceit, I dreamed that from the same source might be let drop hints which might have led to improvements in the Nernst lamp.

R. A. P.

P.S.—Can any of your readers tell me of a suitable cement for refixing resistance holders in type "A," and the pins in caps of type "B"?

Contractor v. Hawker.

As a regular reader of the Electrical Review I noticed some time ago letters referring to the unsatisfactory state the trade has now reached. I may say that I was sorry to see that such an important matter was so lightly treated and ended in the usual way, namely, "smoke." The Editors were kind enough to ask any of the readers to vent their opinions as to how we could overcome the difficulty from which we were suffering. If the Editors will be kind enough to spare me a column or so, I will endeavour to show how I think the difficulty could be overcome. We, as contractors, are between the maker and the consumer (in some cases only). I will give one case, and one only, as I think it will suffice.

About three months ago a firm of lamp-makers put a new lamp on the market which has quite a number of good points, namely:—(1) The current consumption; (2) The increased candle-power for the current consumed; (3) The whiteness of the light; (4) The length of life. I know for a fact that the list price of this lamp was 2s. each, and at this price the contractor is supposed to sell it. As a contractor I at once called on a few of my customers and propounded my theory of money-saving to them, after which I booked a trial order, the price being 24s. per dozen. I left them for a few days, and on going back to procure the rest of the order, found to my astonishment that a hawker or contractor of some sort had offered the lamp at 21s. per dozen. I may mention that the supply of this lamp is not equal to the demand, and I am sure that your readers will agree with me in saying that I think it a pity to see such stupidity under these circumstances.

Now this is not only hurting the contractor, but is going, indirectly to hurt the maker, for the cutting has started, and before long the lamp will be sold at such a price that it will be shunned by all, as the profit on the price it has to be sold at will not be worth working for. If you go to the agent and explain this to him, he will turn round and tell you that if you buy a lamp at 2s., you can sell it at what you like; so the cutting goes on till the lamp is being sold at ½d. of profit per lamp. When it reaches this state, it is left alone, and the maker cannot understand how the sale of the lamp has fallen off so much: but when he finds out the cause, he has to be content with a small sale once more. To do this, the lamp-workers are put on piece-work, and the lamps are rushed through, likewise the tests, the result being faulty lamps and a great deal of trouble, whereas the lamp would maintain its standard if the first price had been adhered to. I state that there are a number of other articles that have lost their standing by being cut to death. I think the manufacturers should take a stand, and have a form drawn out for contractors to sign before they are allowed to trade with any particular firm. The form could be worded to the effect that the undersigned agreed to sell the firms' goods at their list prices. If they, the undersigned, should be found selling any of the goods under the list prices, they need not ask for any further supply, as they have broken their agreement, &c. I am sure, if some of the firms tried this plan, they would be more than pleased with the result. I am also sure that it would improve all branches of the trade. As things are at present, contractors have a very poor time of it, for we have to pay our office and workshops, rents and taxes, also the staff inside and outside. All this has to be done against men who are working from their house or model lodging-house, or from wherever they are staying.

What I have stated above I know to be true, and I am sure that others will agree with me when I say that, if my plan were agreed upon, contractors would then all be quoting on the same footing, and our trade would soon come back to its old state. In conclusion, I would once more impress upon the wholesale manufacturer and agent that it is they, and they only, who can improve the state of the trade or profession, by arranging among themselves some such thing as I have already mentioned. The practical and theoretical contractor is the man who raises the demand for any good lamp or other article that is put on the market by the maker; then I say, why should the maker not do something in return for them, instead of backing up hawkers who do not know the first principles of electricity. All that these men can do is to go round to other people's customers that they see are trying the lamps and offer the same thing at a cut-throat price after the contractor has wasted perhaps one, two, or even three hours showing his client how he could achieve a good saving on his electricity bill, with the result that the experienced contractor shows the saving, the hawker lifts the order, and the contractor is left to mourn over the loss of his time. I trust that I have not once more wasted my time, and that something will be done by the makers and agents to help us in this matter, as it is high time something was done to put things on to a proper basis.

Stephen M. Johnstone.

Glasgow, *December 20th*, 1904.

The Inspection of High-Speed Engines.

I am indebted to your correspondent, "S," for his notes on my article concerning high-speed engines; in one or two points, however, I think he has understood the scope of the article to extend beyond the limits intended by me. For

example, though I am quite in accord with "S" in advising the inspection of an engine before each run, my notes were confined to the more detailed inspection "after overhauling." The article, also, had no reference to altering the rated output of the engine, but to reinstating it in its normal condition. The alteration of the rated output to an overload is hardly fair to the maker, who would probably disclaim responsibility in the further running of the engine.

Other points raised are questions of judgement. In my opinion it is better for the responsible engineer to have inspected his engine at the time it passed from the fitter to the driver, than to rely on a mental calculation of probabilities after an accident. Otherwise, human nature being crafty, if there is a loophole of escape from blame the guilty person will try it. Again, an incorrect clearance or other displacement cannot always be detected by a hand-and-eye inspection before the engine is closed in; something *may* jamb, therefore no one would lose his reputation as an engineer if he barred his engine round a few turns before putting on steam. As regards cylinder lubrication, the amount varies with the wetness of the steam used; in modern superheated steam stations ample lubrication is essential. Now, the article was intended as far as possible to cover all cases; it was stated that partial repairs required only part of the treatment prescribed. I think that "S" would agree to use a full stream in his sight-feed after, say, putting new piston rings in, on the trial run. If the station has an artificial load, the engine can be run loaded. It is, however, in my opinion unsafe to put an untried engine on load unless a spare set is kept running, or the lights do not matter. "S" considers half an hour long enough for a bearing test; I would differ, especially with large enclosed sets.

I would also differ from "S" in being content with a card taken on atmosphere, the engine running slow. With a high-velocity engine a card alone is of little value. This is seen if a set of cards is reduced to a crank-effort diagram, allowing for the inertia of the reciprocating parts. My point was that a distorted card is sometimes advisable to neutralise inertia effect.

The running of an engine is, as your correspondent points out, a question of time and finance as well as engineering. It is the writer's opinion, however, that when an engine has been overhauled, the brasses let together, bearings scraped, &c., it is well worth the expense after an adequate run on load to examine the main parts in as thorough a manner as possible. A little attention after a week's run may save pounds of damage and is hence true economy.

A Power House Engineer.

Re Home Office Regulations.

It has been pointed out to me that my article on the above, which appeared in your issue of the 9th inst., seems in some respects to confirm an existing impression that these regulations cover more ground than do the Board of Trade regulations. I fear, therefore, that I did not make it sufficiently clear that I was comparing the proposed Home Office regulations with the old Board of Trade regulations concerning motor installations, and not with the proposed modifications to the latter. They are really not quite so stringent as the amended Board of Trade regulations.

Frank Broadbent.

4, Queen Street Place, E.C.
December 20th, 1904.

The Cult of the Marine Engineer.

If "Voltboy" really wants to know the station to which I refer, he can ask the editors to kindly forward to me his name and address, when I will not only give him this information, but the names and training of our shift engineers and fitter (marine engineer), but only as private information. I think this is fair. I might mention that I am chief assistant in this station. The staff is not "remarkable," but a *proper* one from the chief downwards—leaving myself out of the question—although it is only for a station of a little over 1,000 KW. capacity. I have been for 10 years in central stations, and during this time I am thankful to say that I have never "struck" one run as "Voltboy's" "own of over 3,000 KW. capacity."

"If any profit is to be made by an electrical undertaking, where does the scope lay? Not on the switchboard, but in the engine room and boiler house." Now these remarks will surely make others think that "Voltboy" is really a boltboy, and still has a lot of elementary knowledge to learn. The profit of a central station is not made on the switchboard or in the engine room, or in the boiler house (although money can be wasted in all three places), but in the chief engineer's office. A good chief will see to it that he has a good staff, even if he has to pay more, and then will manage this staff to the best advantage by giving each man some individual responsibility and an interest in his work. The chief of "Voltboy's" station, to put it quite plainly, is a fool for having such one-sided men in his station, even if they are paying for the work (which in these days is quite possible) or are councillors' or his own relatives.

In conclusion, let me ask "Voltboy" what on earth there is to "thoroughly thrash out." "Voltboy" and other boys can write until they have thoroughly worn out the worthy editor, and what then? How far have they got? What good have they done? Whom have they influenced? Let these boys "thoroughly thrash out" a career for themselves, for even if they are not properly trained, they can be trustworthy and energetic, and honest in their work, and love their central station as if it belonged to them, which things bring a great reward and a salary to live on—in time.

No Name.

It seems to me that almost all your correspondents on this subject rather miss the real point, and in most cases personal feeling has been a more prominent factor than useful argument.

I do not think the question is whether a marine engineer who knows nothing whatever about electricity is fit to be put in charge of a modern central station; on that point I think we shall all agree; he is not fit. Nor is it any more the question whether the purely technical electrical engineer is fit for such a position; we all ought to agree also, that he is not.

To me the question divides itself into two parts. Is it fair that a man who is well qualified on one side only, either electrical or mechanical, should be allowed to qualify himself by any means he can for the other side as well, and having so qualified himself, that he should be given positions requiring qualifications both electrical and mechanical?

Also, if it is not possible to obtain a man who combines both qualifications, is it better to put a good mechanical man in charge and give him good electrical assistance, or to put a good electrical man in charge, giving him good mechanical assistance?

In the first case, I maintain that it is perfectly fair that the electrical engineer or the marine engineer who does qualify himself for any duties, should be freely allowed to make the most of his knowledge without meeting with opposition or ill-feeling from those who happened to start from the opposite end; give a fair field and let the best man win in every case.

In the second case, I consider (of course I am somewhat prejudiced) that if cost of production is to be a consideration, a good marine engineer with efficient electrical assistants, will make a bigger success of a central station than the good electrical engineer with mechanical assistance, and it is these points to which I think your correspondents might with profit turn their attention.

When our educational institutions turn out a properly qualified central station superintendent, no doubt our managers will know where to apply for such. At present they do not turn them out, and consequently we are concerned to find out what is the best material that lies ready to our hands.

I think we should all welcome and try to get some recognised qualification for this work, and consider that the Board of Trade ought to institute such and hold qualifying examinations on the same lines as they now do for marine engineers. Why demand such precautions in the case of a steamer, and not in the case of a large central station, often placed in the densely populated centre of a town?

I cannot agree with your correspondent "No Name" as to the requirements wanted. A power house superintendent, or even shift engineer, should be properly qualified for that post, not be a jack-of-all-trades; and I think that much of the dissatisfaction at the present time is caused by our young men wanting to qualify for so much that they are not more than half qualified for anything.

Also, is it not a mistake to appoint *engineers* as *managers* of large concerns, where surely a business training is of more importance than a knowledge of engineering details, which might well be left to the departmental superintendents?

Marine Engineer.

Telephone Trunk Apparatus.

Replying to "Enquirer's" letter in your issue of December 16th, we have in use at our office an instrument for indicating the three minutes' conversation allowed for telephone trunk messages. The maker is Conrad Felsing, Berlin.

The Chloride Electrical Storage Co., Ltd.
E. Vail Stebbins, *General Manager.*

December 19th, 1904.

SOME ANOMALIES OF MUNICIPAL TRADING.—I.

By Y. Z.

The constitution of a municipal trading concern as compared with that of a limited company presents some interesting anomalies.

Municipal shareholders or ratepayers are compelled to mortgage their property to borrow money at a fixed rate of interest and repayment, in order to invest it in a speculative venture in which they are compelled to make good all losses upon a nebulous prospect of a reduction in their rates. They cannot dispose of their interest because they have no shares, and in the event of their ceasing to pay rates, their invested capital is confiscated. Their influence in the management of the business is not in proportion to the amount they are compelled to subscribe, and it frequently happens that the minority in financial interest are represented by the majority of directors.

Beyond the amount at which they are rated, the directors or councillors have no monetary interest in the business. They may not receive remuneration for their services, and they are elected from those whose ambition is a sufficient incentive for them to face the possibility of that unwarrantable criticism which is so often directed against persons who honorarily undertake the onerous responsibility of spending other people's money. They are not usually elected on account of any particular ability to manage a trading business, but possibly because of their political opinions, religious convictions, their views on education or vexed local questions. They have none of the personal liabilities of directors, and may lend themselves to financial statements and estimates—the equivalent of a company prospectus—with impunity. If they are detected in spending money illegally they are surcharged by the Local Government Board, but unless the money so spent is applied to their personal advantage, the surcharge is remitted.

The clerk to the Council is the municipal equivalent of a secretary, but, unlike a secretary, he is not selected for his trading qualifications, but usually because of his knowledge of the law relating to Local Government. It is he who prepares agendas, who sits at the right hand of the chairman and often prompts his rulings. He frequently holds several offices, and his meetings are so numerous that he can do little more than represent his juniors. He is usually an adept in the art of borrowing, and his knowledge of book-keeping is that prescribed by the Local Government Board for unremunerative public works.

The chief of the municipal money-spending department is the borough surveyor or engineer. This official's duties are multifarious and embrace many branches of the engineering profession. In the eyes of the average councillor, fees paid to experts are regarded as a waste of public money, consequently the surveyor is often called upon to undertake all the engineering and architectural work of the district. To him falls the task of preparing plans for sewage and refuse disposal, roads, sewers, an isolation hospital, public baths, a library, a town hall, sometimes even electric lighting, electric tramways, and other works, all of which have come to be regarded as within the scope of a local authority. The part he plays in municipal trading is all-important. His projects very often include some trading inducement. For instance, a dust destructor is required, and a report is drawn up, showing how profitable it would be to utilise the heat for raising steam for electric lighting, and the clinker and ashes for building purposes. Public offices are wanted, and it is shown that the addition of halls for public entertainments would pay for the cost of the offices. Not infrequently a sewage disposal scheme includes the sale of manure, while electric lighting, electric tramways, baths and minor undertakings in which municipalities are permitted to trade will, in his estimation, yield a profit after the first year's working. His reports are circulated amongst the councillors, who not infrequently discuss commercial questions on party lines, often to vituperation.

When one of the projects is decided upon by a majority of the Council, an application is made to the Local Government Board for authority to raise a loan. The amount applied for is not, as a rule, that of the original estimate, for the municipalist knows that rarely is the expenditure within the estimate, and although hypothetical profit may be based upon this estimate, it is wisdom to him to borrow too much rather than too little. In any case the whole amount is usually spent, and in some cases a further loan has to be raised before the work can be completed. Thus is it that work initiated with loud talk of profit so frequently adds to the ratepayers' burden.

THE ELECTRICAL SMELTING OF IRON AND STEEL.

A final report has recently been published by the Commission appointed by the Canadian Government to inquire into the different thermo-electric processes employed in Europe for the reduction of iron from its ores, and for the manufacture of steel. The Commissioners visited the plants at Gysinge and Korfors in Sweden, La Praz and Livet in France, and Turin in Italy; but their most important investigations were carried out at Livet in the works belonging to Keller, Leleux & Co. As described in their report, the Keller furnace consists of two square iron chambers lined with refractory material and arranged side by side. The base of each is a carbon block. A horizontal channel connects the bottom of the two chambers, and an external cable brings the two carbon blocks into electrical contact. The electrodes are built up of square carbon rods into square masses 35 in. in diameter and 55 in. long. These hang vertically, one in each chamber. The current comes from a 16-pole revolving field alternator, which gives an E.M.F. of 60 volts and a frequency of 50 per second. It passes to one electrode, downward through the charge to the carbon block; thence it goes, either by the external cable, or, when the furnace is in full working order, through the fused metal lying in the horizontal passage, to the second block, then upwards through the charge to the second electrode. By this arrangement the furnace can be worked continuously, for there is no interruption of the current when the molten metal is tapped, and excessive variations in the load on the generator are avoided. It is claimed for this furnace that the consumption of electrodes is small, for the tension of the current is so relatively low that they are not attacked, while their heated ends are completely submerged in a reducing medium. M. Keller holds that the pair of electrodes above described will last for 20 days in a furnace producing 10 tons per 24 hours, the cost per ton of metal being 75 cents. His total estimate for the cost of manufacturing pig-iron, exclusive of royalty, comes to

$10.71; hæmatite being taken at $1.50, coke at $7 per ton, and energy at $10 per H.P.-year.

Mr. C. E. Brown, of Peterboro', the electrical member of the Commission, finds that the furnace can be run for indefinite periods without stoppage; that one man can regulate the current for four or five furnaces by hand-adjustment of the electrodes (chiefly), or (if necessary) by adjusting the alternator field and the water-wheel governor; and that a device could easily be adopted for automatic regulation. During two experimental runs in two different furnaces which lasted three days each, the energy consumed was measured in a specially calibrated Thomson meter, the volts and amperes by the ordinary (uncalibrated) switchboard instruments, and the power factor by Prof. Barbillion by means of the oscillograph. The mean results were as follows:—Volts, 70·2; amperes, 9,895; power factor, 0·737; mean watts, 511,945. In the production of pig-iron, the consumption of energy per short ton was 3,110 KW.-hours in the first experiment, and 1,475 in the second; the corresponding figure in the Héroult process being 3,080. In the manufacture of steel by the Keller process, the consumption of energy was 730 KW.-hours per ton of ingots; the corresponding figures in the Héroult process being 1,000, 1,000 (tool steel), and 653 (structural steel); and in the Kjellin process 757 and 947. The currents used in the Keller furnace are so heavy, that the generating station should be alongside the plant if great losses in the conductors are to be avoided, and if those conductors are not to be excessively costly; or, if the current is generated at a high voltage, the step-down transformers must be similarly close to the metallurgical plant. New furnaces are now being designed with four "shafts," which will facilitate the use of quarter-phase current, and for them three-phase current may be generated and transformed to the working voltage.

Mr. F. W. Harford, whose services were retained as metallurgist to the Commission, reports that steel, equal in all respects to the best Sheffield crucible steel, can be produced by the Kjellin, Héroult, or the Keller methods at a considerably lower cost; but that structural steel of Siemens and Bessemer quality cannot be made economically in the electric furnace. Generally speaking, the reactions in the electric furnace as regards the reduction and combination of iron with silicon, sulphur, phosphorus, and manganese, are similar to those of the blast furnace; and by regulating the current any grade of iron, from white to grey, can be produced, while the quality is under more rapid control. Grey pig-iron, suitable for acid steel manufacture, or for foundry purposes, can be produced; and a pig low in silicon and sulphur, suitable for basic steel manufacture, can be made, provided the charge contains oxide of manganese, and the slag is kept basic by additions of lime. Moreover, there is reason to believe that if the slag be kept basic and fluid, a pig low in sulphur and silicon can be obtained without any addition of manganese. When electrical energy costs $10 per H.P.-year, and coke $7 per ton, pig-iron can be made in the electrical furnace at approximately the same cost as in the blast furnace. Under ordinary conditions, where blast furnaces are established, electric smelting cannot compete; but where water-power is ample, and furnace coke not readily obtainable, it may be commercially successful.

REVIEWS.

On Recent Contributions to our Knowledge of the Floor of the North Atlantic Ocean. By Sir John Murray, K.C.B., F.R.S., D.Sc., &c., and R. E. Peake, M.Inst.C.E. London: Royal Geographical Society, 1904.

The recognition given to the earlier essays of Captain Maury, United States Navy, in the introduction to this paper, will afford great satisfaction to navigators and geographers alike, the world over.

His book, "The Physical Geography of the Sea, and its Meteorology," a sixteenth edition of which was published in 1877, was, as stated in the introductory chapter, "a new department of human knowledge."

Research had then become very active in this field, the first treatise on the subject having appeared in America in 1871. Subsequent editions kept pace with the rapid development of commerce and navigation, and were mainly in the interests of navigators, but the advent of the Atlantic Telegraph Cable in the fifties evidently inspired Maury with the idea, that a peculiar feature in the configuration of a section of the ocean floor of the North Atlantic had been designed specially to serve as a safe bed for a submarine telegraph line between the Old and the New Worlds.

How, subsequently, the rapid and extensive developments of Atlantic telegraph cables have modified the views of those days is well known, but it was fully 20 years afterwards that those interested in projecting, and others engaged in laying cables, began to realise the necessity of knowing considerably more about the depths of the ocean than could be derived from the then accepted ideas, based upon insufficient research.

Maury was, to all intents, a practical philosopher, and possessed a quick faculty for grasping physical facts. Brookes's sounding tube brought up from the sea bottom the first specimens, and from a microscopical examination of these Maury reasoned, from the fact of their being composed entirely of minute calcareous shells, that there could be no currents at the bottom of the sea, and that the safety of a telegraphic cable, once deposited in its oozy bed, would be assured.

This fact is as true to-day as when it was written, and Maury further showed considerable judgement, and a prevision of future difficulties, in pointing out that such would be found, not in the deep sea, but at "either end of the line, on reaching shoaler depths."

Dealing with oceanographical research of a more recent period, the Prince of Monaco is mentioned in the publication before us as having carried on exploration of the deep sea since 1885, and it is stated that he is now founding an oceanographical institute at Monaco.

The Prince has been, we have understood, assisted throughout in these researches by his friend, Mr. J. Y. Buchanan, F.R.S., formerly of the *Challenger* staff.

Recognition is also given to the very large proportion of information obtained from the sounding work of telegraph ships belonging to the different submarine cable companies and contractors.

The depths of the North Atlantic Ocean, as shown with such clearness of detail and colouring, over their respective areas, in the reproduction of the Admiralty chart appended to the paper, offer a striking contrast to the meagre information conveyed, in earlier days, by Lieut. Maury's map of the North Atlantic of 1854, excellent in its careful drawing and detail, derived, as it was, from the best knowledge extant at that time. Here, in 1904, the authors have presented a chart with the sea floor mapped out, showing the elevations and depressions, as correct in general features as the hills and plains on a continental map of the land, and the character of the deposit on the sea bottom may be determined with the same accuracy as that of the soil on the surface of the earth. The delimitation of the areas of the great deeps indicates most careful work, both in sounding and surveying, and equally so in the determination of the direction followed, from north to south, of the Dolphin Ridge, forming the central plateau of the North Atlantic basin between 30° and 50° north, and of its twin connection with the Challenger Plateau down the centre of the Atlantic South. In regard to the deeps, it is stated that these great depressions in the ocean floor "descend about 20,000 ft. below the level of the waves," and that if the highest mountain in the world were placed in the Nares deep, it would form an island, the summit of which would be about 1,000 ft. above the water. Very little attention has been given to the Newfoundland Banks, beyond the mention of the 4,000-fathom area shown on Maury's map to the south, the position of which great depth is said to correspond with that now occupied by the Suhm, Thoulet, Sigsbee, and the Libbey deeps.

The temperature, salinity and currents in the Atlantic are said to present much greater variety and contrast than in any other great ocean basin, which, it is said, arises from the general atmospheric circulation, and its influence in driving the heated water of high salinity of the tropics through the Gulf Stream, and, at the same time, forcing cold water of low salinity down from the Arctic Ocean.

The average temperature over the floor of the North Atlantic is said to be 2° F. above the average temperature of the bottom of the Indian and South Atlantic Oceans, while the temperature of the bed of the Pacific is intermediate between the two.

In the interesting account given of deposits and rock fragments collected from the floor of the Atlantic, mention is made of several pieces of rock having been broken off transported boulders by a Lucas grapnel, which, it is assumed, in hooking a rock might probably bring a strain on the wire lifting rope sufficient to break the retaining pins, thereby releasing the arms from the shank, and causing them to close on the boss and nip off a piece of the rock.

Pieces of rock have frequently been brought up on an ordinary grapnel from the sea bottom, and very undesirable specimens they are to bring to the surface in deep water instead of the cable.

An interesting point brought out by some recent cable repairing expeditions, it is said, may afford a hint as to the deposition of Globigerina ooze. Two instances are referred to of a cable being raised in deep water and repaired with an interval of 15 years between, no deterioration of the cable having taken place; this was ascribed to the fact that it was embedded in the ooze, and it was considered fair to "assume a period of 10 years for the accumulation of a layer of the deposit 1 in. in thickness, in latitude north 50° longitude west 31°, depth 2,000 fathoms."

"If, therefore, this theory is correct"—the authors go on to say—"it furnishes an approximate idea of the rate of the deposition on the bed of the ocean, a point on which, up to the present time, it has been impossible to form even the vaguest estimate."

There are two appendices :—

1. By John S. Flett, D.Sc., F.R.S.E., giving a report on the rock specimens and some of the oozes collected by the ss. *Faraday* and ss. *Minia* from the North Atlantic in 1903, and

2. Lists of soundings taken by the same vessels in the North Atlantic during the same period, and indicating the type of deposit and percentage of calcium carbonate.

Dr. Flett, in his remarks following the descriptive list of rock specimens, says that "they varied in size from 4½ in. in diameter down to small pebbles the size of a bean, and that some of the larger stones have that blunted form characteristic of boulders which have formed part of a ground moraine. . . . . Some of the smaller pebbles are angular, but others are rounded as those from a stream or a sea beach."

In respect to this, it has also doubtless become well known that these specimens are similar to the stones that strew the sea bottom over a large area of the Grand Banks. A very close and careful analysis has been made of the Globigerina oozes, the general results of microscopical examination being summarised in a brief yet comprehensive manner, showing mineral impurities to be of three kinds—volcanic particles, minerals formed *in situ*, and transported fragments, the purest ooze resembling the highly calcareous Globigerina oozes described in the *Challenger* report.

Appendix 2 gives geographical positions, depths in fathoms, and deposit for each sounding taken, finishing up with descriptions of three typical samples of Globigerina ooze.

Concluding this notice, we congratulate the authors on their work, which constitutes a most valuable and interesting addition to the literature of the study of ocean depths.

We would refer our readers to previous publications by the same authors, reviews of which will be found in our columns. See Electrical Review, 1899, May 19th, Vol. 44, page 818.; also 1901, May 10th, Vol. 48, page 820; and 1902, Vol 51, pages 361 and 401.

Electrical Installations. By Rankin Kennedy. London: The Caxton Publishing Co. 1902.

This work embraces the whole of electrical engineering, and consists of four volumes, with a fifth added as a supplemental volume, dealing with telegraphy, telephony, and medical electrical science.

The author's object, as set forth in the preface to Vol. I., is to describe in detail, first, the scientific principles upon which electrical engineering is based, and secondly, actual practice in the various branches.

It is, therefore, a very pretentious work, but, being written in a popular style, as is usually the case with popular books on highly technical subjects, it contains many errors, and conveys somewhat strange misconceptions of those very principles which it aims at elucidating.

As a compilation of descriptions of various types of machinery, electrical apparatus and appliances, however, it deserves commendation, as it contains a large amount of useful information and much interesting matter, and must have entailed considerable labour on the part of the author.

In Vol. I. are discussed the different principles (Ohm's law, electro-magnetic induction, &c.), and descriptions of measuring instruments, dynamos, motors, alternators, cells, arc lamps and meters are given. This volume opens with an introductory chapter, illustrating the flow of electricity in a circuit by means of the well-known water analogy. We find a horse-power defined as 33,000 ft.-lbs. We cannot regard this as a slip, as it occurs only too often; it should not occur at all. Fundamental principles and definitions should, at least, be correctly stated.

In pursuing the water analogy, which, like most analogies, fails when carried too far, the author states that, to obtain units for calculations, it would be easy to make them such that *volts* were equivalent to *feet* and *amperes* to *pounds*. The *volt* refers to electrical pressure and the *ampere* to rate of flow of electricity; whereas the *foot, per se*, does not refer to the height of a liquid column or head of water, and the *pound, per se*, is absolutely independent of time and has nothing to do with water flow.

A difference of electrical pressure of 1 volt may certainly be said to be analogous to a difference of water level, or head, of 1 ft.; and, further, for the purpose of illustration, a current of 1 ampere may be said to correspond to water flow at the rate of 1 lb. per second. The whole object of such statements is, no doubt, to make the study of electric phenomena easily understood by introducing comparisons with which the ordinary individual is familiar, but it is most regrettable that fundamentally erroneous ideas should be inculcated by the use of false analogies.

In Chapter II., on Ohm's law, we are told that "*energy* is equal to *current multiplied by the pressure, and the product (of C. E.) is watts, i.e., the unit of energy.*" Surely, in a serious work on electrical engineering one does not expect to find such palpable errors. (The italics are ours.)

In Chapter III., which gives methods of electrical measurements, following upon the description of the Ayrton and Perry magnifying spring ammeter, *carbon ribbon* twisted in the same way is suggested for use in an instrument on the hot wire principle, as it will untwist on being heated by a current passing through it. We are not sure whether this is a misprint or seriously meant.

From Chapter IV., on electro-magnetic induction and magnets, we merely quote the following passage:—"Fig. 92 is an illustration of a bar magnet, showing the lines of force in and running from it. The maximum force is at the middle, inside the magnet; the force escapes, so that at the ends there is not much magnetism issuing, or, to put it better, not many lines of force passing out, not nearly so many as pass through the mid-section of the magnet."

In Chapter V., which bears the title, "Electric Pressure from Engine-Power Continuous Currents," the formula for determining the E.M.F. generated in an armature revolving in a field of strength Z, having N_t turns of wire on the armature and making N rotations *per minute* is given as

$$E = N Z N_t 10^{-6}.$$

Z is here equal to the number of lines in the C.G.S. system of units divided by 6,000. This is not expressly pointed out by the author, but in the previous chapter the system of units based on the inch-lb. system proposed by Mr. Gisbert Kapp is mentioned and explained, and, no doubt, Z is in "English" lines of force and not in C.G.S. lines.

Chapter VI. deals with the theoretical considerations of alternating current motors and generators. The diagram (fig. 154) illustrating the three-phase star system, with a

fourth conductor from the neutral point, is not quite correct.

The theory of induction motors is more or less expounded in three pages, and the author states that the rotating field theory is quite unnecessary to explain the action of either mono-phase or poly-phase motors.

Chapter VII. gives some elementary notions of dielectrics and electrolysis; and the two final chapters of this volume treat of instruments, meters and arc lamps.

The author's exposition of what he calls the true science of the motor-meter with magnetic brake is decidedly novel, but unfortunately incorrect. In connection with a meter having a permanent magnet to produce a constant field, in which rotate both the brake disk and the armature, carrying the current to be metered, and which is, therefore, an ampere-hour meter, he states that doubling the current doubles the speed, and therefore the *torque is squared*. In such a meter the driving torque is proportional to the current, and the resisting torque is proportional to the speed. The condition for either equilibrium, or steady motion, is that the two torques are equal, from which, neglecting friction, it follows that the speed varies as the current.

The author, however, says that *both the motor and the generator* (the generator is the brake disk in the permanent magnet field) *follow the square* law, and, therefore, direct proportionality between the speed and current results. He also makes the assertion that the ordinary magnetic brake acts as *the square of the speed*, and that the usually accepted law—that the resisting torque is proportional to the speed—is due to a mathematical fallacy!

Further on the following passages occur:—

"In another meter successfully used the motor has a constant current in the armature, and a variable field in series with the load. The generator is on a constant field. In this case the speed is same as before, proportional to *current* passing in the motor—this time through field of the motor.

"*Mechanically, if we have twice speed at twice torque, the power required must be as the square.* This *explains* why the Schallenberger meter, which has an air brake in shape of a fan, works as well as the magnetic brake in a meter."

We have quoted verbatim in consequence of the author's remark that these considerations are of importance to students and investigators, and that *correct notions throw floods of light on obscure problems!*

We can only express our regret that such incorrect statements should appear in a book of this description.

The subject of meters is continued in Vol. II. This book is mainly descriptive of instruments, transformers, installation wiring, switches and switchboards.

Volume III. is devoted to descriptions of the means of production of electrical energy, prime movers, generators and motors, and is fairly comprehensive, containing some representative types of machines, &c.

In Vol. IV., the last of the heavy electrical engineering series, the more complete installations for electric light and power transmission are considered and examples given.

This volume is the best of the four books, and includes many very good illustrations, together with useful data, such as gas engine tests, comparative cost of running oil engines, isolated installation costs, &c. Traction systems are discussed, and the special applications of motors.

The final chapter gives an account of distribution and transmission schemes. A general index for the first four books is included in this volume.

Volume V. refers to telegraphy, telephony, wireless telegraph systems, X rays, and the applications of electricity in surgery and medical science. The first chapter again shortly reviews the principles of electric and magnetic phenomena. A slight slip occurs in the formula for the frequency of the oscillatory discharge of a condenser. It reads $\frac{1}{2\pi n \sqrt{KL}}$ instead of $\frac{1}{2\pi\sqrt{KL}}$. Some very interesting matter is contained in this volume, and numerous illustrations are given of the different instruments and appliances used. A separate index is added.

THE TRAINING OF A COMMERCIAL ENGINEER.

By T. W. SHEFFIELD, A.M.I.E.E., A.M.I.M.E.

It may, perhaps, be necessary, at the outset, to dispel the illusion of those who fondly imagine that success in commercial engineering may easily be attained without any specific course of training. In this, as in most business callings, there is no royal road to success, and the importance of a sound training can scarcely be over-estimated. The observations of the writer are made from the standpoint of the training for a general or mechanical engineer, and may differ somewhat from the case of the purely electrical engineer who is taking up the commercial side of the business. It will be sufficient to touch briefly on the main features underlying the career of a commercial engineer, as the side issues are far too numerous for one to attempt to deal with them in a single article.

Workshop Experience.—There can be no gainsaying the fact that the first qualification of the commercial engineer is the serving of his apprenticeship for at least two or three years, in order that he may acquire a thorough practical training in the different shops, completing his third or fourth year, as the case may be, in the drawing office. In dealing with the younger generation of engineers, it is assumed that they have qualified for the drawing office by attending science classes two or three evenings a week during their apprenticeship.

Office Experience.—It is here that the commercial engineer obtains his knowledge (during the last year of his apprenticeship) of office routine, which, when brought into practical use in conjunction with his commercial undertakings, so materially assists the head office in dealing with the quotations sent out. As the trained engineer knows, the slightest rearrangement of the plans submitted generally means leaving a margin of profit, as the client usually wishes to moderate his scheme, when his decision has to be given from a monetary point of view. Here again the trained commercial engineer has the advantage of discussing the merits of the scheme submitted, and if his arguments are tactfully brought forward, his client is induced to settle the question at issue, and he thus secures the contract.

The above remarks show the importance of office training, especially if the experience is combined with one or more of the commercial departments. In connection with this, it is interesting to note in passing that these departments are practically almost closed to pupils when serving their apprenticeship; the consequence is that, although they are getting out designs for plant sometimes involving many tons of material, they have not the remotest idea of the price of material employed in the castings and forgings from their designs. This is manifestly incorrect, and whilst it will, perhaps, be admitted that it is not necessary for the engineer to know how the cost of a contract is arrived at by the estimating department, it is only reasonable to expect that he should know the cost of general materials that will be used in his designs. To the commercial engineer the knowledge of the price of materials is highly essential, in order to enable him to point out the advantages of his firm's superior production over that of their competitors, who may possibly use cheaper material in some important section or part of the plant or machinery for which he is negotiating the sale. In dealing with a question of this nature, there will be exceptions in many cases. However, the exceptions can take care of themselves, as it is to the majority that this advice will commend itself.

Age.—This is a somewhat difficult question, but it is not without its interesting features. The writer will, therefore, assume that the commercial engineer has completed his apprenticeship, and has acquired a fair office experience with some sound ideas on organisation, the result of the experience gained on outside contracts for his firm. Without the qualification of an organiser, his outdoor work will prove a partial failure, as it requires this gift highly developed to ensure his meeting the wishes of the large *clientèle* which,

in these days, he is expected to control. Assuming that he is 21 when completing his time in the office, and that he has subsequently had one or two years on general work, he is entrusted with following up contracts for his firm, allowing him 12 months to get thoroughly acquainted with his firm's smaller customers.

It will be seen from the foregoing that he is reasonably young, considering the keen competition he has to face. From this time onwards he will be gaining that specific knowledge of the *clientèle* under his supervision which is invaluable to himself and his firm, and this can only be obtained in time. It may take several years to develop the tact, discretion and diplomacy which are required to secure the acceptance of his firm's contracts by large co-operative bodies, and it is only after a lengthened period of time, combined with the foregoing experience, that the commercial engineer is qualified to undertake the sole administration of commercial departments, and to control assistants generally on the commercial side of manufacturing concerns.

A Comparison. — The writer has had considerable experience with the American systems of conducting the commercial side of their electrical undertakings, and must candidly admit appreciation of some of them; for there is no doubting the fact that greater attention has been paid by them, to the commercial side of engineering than has been the case with English concerns, with the result that many useful lessons can be learned from their methods. This is especially so when we take into consideration the amount of capital devoted to distributive literature, and judicious advertising relating to specialities, and how forcibly these are kept before interested buyers and prospective dealers, by means of a carefully compiled mailing list, which is always kept up to date, so far as changes occur concerning the probable requirements of each individual firm or client. This system, being under the firm's direct control, is obviously better than entrusting such an important matter to some circular-addressing agency, a practice still adhered to by many English firms. There are naturally many interesting incidents that could be given, showing how, to the minutest detail, the organisation of their commercial departments is carried out. I can only comment briefly on these, in order to point out the assistance which the commercial engineer receives from the same in his undertakings, and my remarks in this connection may be concluded by mentioning that the commercial departments invariably supply their commercial engineers with a complete set of data books, in pocket form, containing illustrations of the different parts of the machines, together with efficiency curves, dimensions, weights, &c. These are invaluable when the representative is dealing with a client, when out of touch with the head office, and very often this information leads to settling the contract on the spot, which necessarily minimises waste of time and money, both to the client and the firm.

From the foregoing it will be seen that the American commercial engineers have many advantages over the English commercial engineers, who have to secure their business under old and obsolete methods, which is mainly due to that conservatism so characteristically British. Notwithstanding this, the English commercial engineer has one great advantage, in the fact that he generally approaches his clients with the desire to learn their requirements, and quote accordingly. This approved method of procedure is far more likely to bring off the business successfully than the rule of dictating what is necessary, and thus running the risk of giving offence, which is so frequently done in American commercial practice, resulting in loss of business, and dissatisfaction generally.

Conclusion.—Whilst admitting that some of the foregoing remarks are somewhat flattering to the American system, I maintain that there are many qualified British commercial engineers of the class mentioned in the opening remarks who, when supported by modern administration, can easily hold their own in the home and colonial markets. It therefore behoves our manufacturing firms to take the initiative in assisting the present commercial engineer in the minutest detail of his calling, and also to give renewed attention to the future qualifications of their commercial staff, in order to meet the ever-growing competition on the commercial side of engineering.

SOME VITAL POINTS IN MANUFACTURING.

[COMMUNICATED.]

The writer is not at all pessimistic as to the capacity of the English manufacturer to hold the field in the face of foreign competition, provided that principles of the highest importance are more freely adopted and carried into effect.

Every manufacturer should be a specialist in some branch of trade, working from thoroughly standardised designs, for by this means only can cheap production be made possible. Of such paramount value is this point that attention must again and again be called to it in the technical Press until it is well driven home. Another weak spot, and a costly one, indeed, is the multiplication of designs in apparatus for effecting a given purpose. Especially is this to be noticed in the electrical fittings department, where the array is positively bewildering. The number of designs could certainly be reduced with advantage to both buyer and seller.

An observant buyer cannot fail to be impressed by the persistency with which certain designs of electrical apparatus comparatively obsolete are pushed and advertised.

Surely it would pay the firms responsible to re-design such uninteresting apparatus and bring things up to date.

Perhaps definite mention of some articles in which English manufacturers are altogether behind the times may be of value.

Hack Saw Blades.—As far as the writer's experience goes, that most useful article, the hack saw, as made by English firms, is hopelessly out of the running when compared with the American article.

The American-made tool is tempered to the hardest degree possible, with plenty of set or clearance, and will cut rapidly and easily, and do a lot of work. When worn out it is thrown into the scrap heap, which is surely better than trying to re-sharpen saw blades of the English type, which are just hard enough to ruin the file. It may be added that the price of the American blades is low, and this allows them to be freely used.

Twist Drills.—Here, again, the Americans take the lead easily, their twist drills being of the highest class and in every respect satisfactory.

Self-Centring Chucks.—These are sent into this country in thousands annually; they are an absolutely essential tool in every workshop, and very costly, and therefore represent a big loss to the English tool maker.

Taking the class of small tools generally, such as micrometer calipers, gauges, hack saw frames, braces, dividers, calipers, surface gauges and similar tools, one cannot fail to admire the handiness, clever design and general excellence which characterises those of American manufacture.

In the electrical section, particular mention may be made of

Circuit-Breakers.—America sends immense numbers of circuit-breakers into this country, in thoroughly standardised designs ranging from 5 to 5,000 amperes.

Starting Switches and Field Rheostats.—Vast numbers of foreign-made apparatus of the above class are used all over the United Kingdom.

Traction Poles or Standards.—American trolley wire standards are used throughout many of the leading tramway schemes in this country. In fact, the quantity of foreign-made traction supplies used in the United Kingdom is enormous.

Now comes the question, can the English manufacturers make and supply all the above apparatus equally as well as other countries? The answer is, Yes. What is principally required is more standardising, greater attention to manufacturing in quantities, more manufacturing specialists, and therefore a less number of firms each making the same article, with a small output for each firm of a given article as at present.

That is the keynote of the position. Standardise, specialise, concentrate your energies on doing one thing well.

Society of Engineers' Jubilee Dinner.—The jubilee dinner of the Society of Engineers was held on Wednesday last week at the Hotel Cecil.

COLLIERY MANAGERS AND THE PROPOSED RULES RELATING TO ELECTRICITY IN MINES.

In a paper read before the Midland Counties Institution of Engineers under the title "Comments on the Proposed Rules for the Installation and Use of Electricity in Mines," by Mr. Wm. Maurice, which is included in the *Transactions of the Institution of Mining Engineers*, the author deals with the special rules submitted by the Home Office Departmental Committee—which conducted the inquiry into the use of electricity in mines—for its installation and use. A similar paper was read before the London meeting of the Institution of Mining Engineers about the same time by Mr. S. F. Walker, with which we dealt in our issue of September 16th last.

In the present paper Mr. Maurice severely criticises the "proposed rules"—one might almost say ridicules them—but in the course of the paper we do not see any suggestions by Mr. Maurice as to what should take their place, except that he "submits that it is the legitimate function of a representative body of mining engineers to draft such precautions as may be necessary, and to modify them from time to time in order to meet changed conditions." From this we take it the author means that the colliery managers who form the Institution of Mining Engineers should make their own rules for the "installation and use of electricity in mines." An "association of mill owners" might easily claim the same thing, but as they are not electrical engineers it is unlikely they would propose anything so foolish.

Judging from the tone of the present paper and from the discussions following both this and Mr. S. F. Walker's paper, it would appear that the colliery manager's objection to the "rules" lies more in his antipathy to having them forced upon him than to any unreasonable conditions or clauses contained in them. For instance, the chairman is reported to have said in concluding the discussion following Mr. Walker's paper, that "his feeling was to condense them into one rule, 'No electricity shall be used in a mine,' as that seemed to be the ultimate effect of the proposed special rules;" and Mr. Maurice, in concluding his paper, says: "In conclusion, the writer submits that although the publications of the Departmental Committee on the Use of Electricity in Mines are of great educational value, the actual carrying into effect of the proposed special rules should be delayed until the necessity for some of them, and the probable operation of others, is more clearly seen. It is not desirable that the Home Office should rush into the issue of numerous special rules, when it is apparent that the necessity for most of them is rapidly passing away." But is it apparent? and supposing for the moment that it is, what objection can there be to a rule which agrees with good practice? Again, "Considerably more than half of the provisions will be found embodied in any elementary text-book. The writer fails to see any more reason why such rules should be made law than there is for legalising the memoranda contained in Sir Guilford Molesworth's *Pocket-book of Engineering Formula*. If it were enacted that neglect to take these precautions, which are commonly accepted as essential to the safe working of electrical machinery and apparatus, be an offence under the Coal-Mines Regulation Acts, detailed rules to meet the situation might very properly be drafted by a committee of experts, as already suggested." The question at once arises: Who are the experts? Surely Mr. Maurice is not going to claim that title for the members of the Institution of Mining Engineers, the main body of whom are *mining*—not *electrical*—engineers, and of whom (excepting those members who are manufacturing electrical engineers) the majority can have at most only a passing acquaintance with electricity, while practically none have that practical knowledge and experience in electrical work which is necessary in order to efficiently supervise the design, installation, and running of electrical plant. The evidence given by mining engineers before the committee is sufficient to justify the "rules" being enforced, and is it not a fact that the installation and working of electrical plant in collieries were so bad, so underpowered, so *rotten* in fact, that the Home Office was obliged to step in? Is the profession of *mining* engineer so easily learnt, that one may become not only a colliery manager, but an expert electrical engineer as well? Or is it not another case of the old saw, "a little knowledge is a dangerous thing?" Because the colliery manager in the course of his training may see electrical plant running in and about the mine, is he justified in claiming the knowledge of an electrical engineer? If so, it would appear to be quite unnecessary for those who aspire to become electrical engineers to attend college, and enter a manufacturing concern as a pupil or apprentice.

In these days of competition and specialisation of professions, it would surely be better for the *mining* engineer to "stick to his last," and leave mechanical and electrical engineering to those who are specially trained to this work. To justify this statement, we may be allowed to quote from a leading article on "The Training of Colliery Managers," contained in the *Colliery Guardian* of May 1st, 1903:—"The head manager, who has all the responsility, should also have the power; and, having these two, the responsibility and the power, he should have the knowledge—a reasonably extensive and general knowledge—of every part of his work, so that he can check and test every machine and instrument he uses. But to be able to do so, in these days of deep mining and labour-saving machinery, requires a far greater knowledge than would have sufficed a few years ago. He must not only be what is termed a good pitman, but must also have no inconsiderable knowledge of mathematics, statics, hydrostatics, physics, chemistry, geology, general engineering, and a host of other sciences. . . . It is essential that the basis of sound instruction in any science should be a thorough grounding in its elements or principles. During the period that these are being inculcated, instructors of mining should claim the whole time of a student. The principle here is beyond contention; the only danger is that it may be carried too far, and an excess of theory may prove detrimental to practical knowledge. Thus, it has been said that German mining engineers know all the sciences pertaining to mining except mining—in other words, they are not good 'pitmen.' After having been equipped to apply the best methods in the best manner, they find themselves unfitted for life below ground. The superiority of our underground work is the best proof of this." It is earnestly to be hoped, therefore, that the British mining engineer, who is acknowledged the best in the world, will not neglect his mining training in order to grasp the mysteries of mechanical and electrical engineering, or, to put it another way, to become a "jack of all trades and master of none."

LEGAL.

The Yorkshire, &c., Tramways *v.* Ellis.

In the King's Bench Division of the High Court of Justice, on Tuesday, the Lord Chief Justice, Mr. Justice Kennedy and Mr. Justice Ridley, in this case, heard an appeal by the Yorkshire (Woollen District) Electric Tramways, Ltd., against a decision of the Justices of Dewsbury in the West Riding of Yorkshire, who had convicted and fined them 2s. 6d. The appellants were a light railway company formed under provisional orders in accordance with the Light Railways Act of 1896, and the respondent, Mr. Hiram Ellis, the town clerk of Dewsbury, summoned them for allowing one of their cars to ply for hire in the borough without a licence, his contention being that under the Towns' Police Clauses Act of 1847 the vehicle must be regarded as a hackney carriage. The magistrates had upheld this contention, and this appeal was against their decision.

Mr. Danckwerts, K.C., for the appellants, said the decision that a carriage run upon a light railway was a hackney carriage, carried with it the absurdity that a light railway must get a licence from every local authority through which the line ran, and each local authority would have the discretion of saying how many of these carriages there must be.

Mr. McMorran, K.C., for the respondents, supported the conviction.

The Court allowed the appeal, with costs, and quashed the conviction.

The Lord Chief Justice said they could not come to the conclusion that that which was in substance a railway was to be subject to the provisions of the Towns' Police Clauses Act in regard to the licensing of hackney carriages. The absurdity of the thing was too great. The appeal, therefore, must succeed.

The Electric Traction Co., Ltd., *v.* The Westminster Electric Supply Corporation.

This case came before Mr. Justice Kekewich in the Chancery Division of the High Court of Justice on Tuesday, on a motion for judgement.

Mr Cassel said Mr. Kennedy appeared for the defendants. The motion was for judgement by consent on agreed minutes.

His Lordship assented.

Tramway Company Fined.

At the West Hartlepool Police Court on the 12th inst., the General Electric Tramways Co., Ltd., was summoned under the Tramways Order for not keeping the tramway in Clarence Road, West Hartlepool, in a proper state of repair.

The Town Clerk said that in the view of the Corporation the Tramway Co. had wholly failed to recognise their obligation to the public. The condition of the track in Clarence Road was a matter of public scandal. There was great danger to vehicular traffic and to cyclists. He contended that the repairs that had been done had been inadequate, and said that in some places the track was below the setts. The line had been termed a sort of switchback.

Mr. N. F. Dennis, borough engineer, stated that 51 places in the track in question were defective with regard to the state of the rails and the paving. The rails were too light.

Mr. Harbison, for the defence, said that negotiations were going on with regard to the tenure of the tramways in the West Hartlepool district. The company were anxious to give the public the best service they could, and, as soon as terms were come to, it was their intention to reconstruct the tramways. In regard to Clarence Road, the track was somewhat worn, but they were keeping it in as good repair as they could.

Mr. W. H. Bettison, for the defence, said he had had men working continuously on the road mentioned, and he had not noticed any danger to the public owing to the condition of the track.

The Bench fined the defendants £5 for the offence on October 17th, and £1 per day for seven days after, and costs.

A further charge was preferred against the Tramways Co. in regard to the track in Grange Road and Stockton Road, the alleged

offence being that the wooden blocks were slippery to a degree of danger, but the bench was not satisfied, and dismissed the case.

A third charge was of using three cars that were not free from noise produced by the clatter of machinery, on October 26th, 1904. Mr. Simpson put in a letter from the Tramway Co., in which they stated they would do their best to minimise the alleged noise. After hearing evidence, the Bench fined the defendants a mitigated fine of £5 and costs.

Brunlees *v.* Mersey Railway Co.

Mr. Justice Lawrence, in the King's Bench Division, on the 21st inst., delivered a considered judgement in this action, brought by Mr. John Brunlees, the well-known engineer, to obtain a declaration that the agreement with the defendants employing him as chief engineer with Sir Douglas Fox was still existing, and to recover damages, roughly estimated at £10,000, for the refusal of the company to engage him in connection with a contract for about £250,000, given to the Westinghouse Co. for the electrification of the line running through the Mersey Tunnel.

It appeared that by an agreement dated May 24th, 1881, the Mersey Railway Co. undertook, on the retirement of Sir Jas. Brunlees and Sir Douglas Fox, to employ their sons, Mr. John Brunlees, the plaintiff, and Mr. Francis Fox. Sir Jas. Brunlees died on June 2nd, 1892, and, according to the plaintiff's case, he had been retained as chief engineer with Sir Douglas Fox, and worked for the company at various times up to July, 1901, when the contract was given to the British Westinghouse Electrical and Manufacturing Co. The defendant company disputed the validity of the agreement, and pleaded that in any case it did not apply to the work in question. They further contended that the agreement was *ultra vires*, the plaintiff alleging that the company were bound by the terms of the agreement to employ him for life, and pay him 5 per cent. on all the rolling stock they bought, the extension they made, and the changes they effected in the working of the line.

His Lordship said the point was whether the agreement was confined to the then existing state of things, and did it cease to have effect when it was decided to employ electrical power. In his opinion, neither party having contemplated any change from the original system of working, this contract was not binding upon the company, but came to an end when electricity was adopted. He therefore gave judgement for the defendants, with costs.

BUSINESS NOTES.

Trade in 1904.—The Mirrlees Watson Co., Ltd., of Glasgow, have sent us a report regarding the advances they have made during 1904 in connection with condensing plant and Diesel engines. As practically all the previous announcements regarding the Diesel engine have had reference to engines made by Continental firms, it is satisfactory to know that a firm of home manufacturers has seriously taken the matter up, and has put an engine on the market after having thoroughly satisfied themselves that it had been developed into a good commercial article. From seven to eight years ago the firm made the first Diesel engine constructed in Great Britain. This engine showed that there were certain difficulties to be got over before the engine was suitable for general use. During the intervening years the firm carried out many experiments and trials, but the present year has seen the development into a completely satisfactory form of this engine. The early troubles of choking of passages and oil sprayers are said to have been quite eliminated, and the company have now had three engines in operation in their own works for 21, 12 and 9 months respectively, and have thoroughly satisfied themselves that the earlier troubles have been completely eliminated. During the year the Mirrlees Watson Co. have done a very satisfactory volume of trade in central condensing plant for electrical stations. Latterly there has been a tendency to adopt dry air pumps and separate water pumps. As the firm have manufactured dry air pumps for some years, this type of pump having been much used on the large central condensing plants on sugar estates, they have had a good experience of this plant, and during this year have supplied several for electrical stations.

Australia.—The Australian Customs authorities have given a decision to the effect that "electric chain mining machines with self-propelling trucks" are to be classified as "electrical machines and appliances n.e.i.," the duty being 12½ per cent. *ad valorem*.

Exports of Electrical Machinery.—A very satisfactory increase is taking place in the exportation of electrical machinery from this country. The shipments during November last were the largest so far recorded, amounting to £64,514, as contrasted with £51,268 in the preceding month, and £23,889 in November, 1903. For the first 11 months of the year the aggregate exports have attained a value of £470,288, which compares with only £394,170 in the corresponding 11 months of 1903.

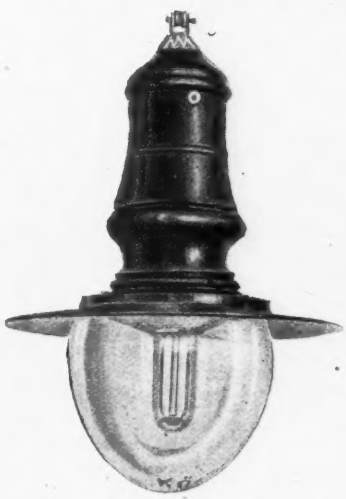
The Edison Battery in Germany.—The New York *Electrical World and Engineer* says that the Edison battery is to be manufactured in Germany under the auspices of the Bergmann Electrical Works, of which Mr. S. Bergmann is the head, at Berlin. Mr. Edison will be a member of the board of directors. Mr. Bergmann has recently been in America in regard to the matter.

Regina Arc Lamp.—This arc lamp, which has been awarded a gold medal at the St. Louis Exposition (the highest award), differs from other enclosed lamps mainly in the system of enclosure; instead of enclosing the carbons only, which cannot be perfectly accomplished on account of the necessity of providing free passage for the upper carbon, in the Regina lamp the whole of the regulating gear is enclosed in the same chamber with the arc—a safety valve being of course provided. It is claimed that the result is more light, and a longer life of the carbons.

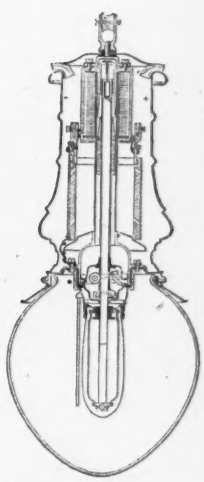
A.C. Lamp with Choking Coil, 100—200 Volts, 3½ to 8 Amps.

Detail of Piston.

The mechanism is very simple, consisting of a cylinder containing a piston, to which the carbon holder and iron core are attached. The feeding device consists of two clutches which grip the carbon, lifting it up when the magnet is lifted by the coil and striking the arc. The piston, with its attachments, is the only moving part, there being no clockwork or other gear.



Lamp for Outdoor Lighting.



Section of D.C. Lamp with Internal Resistance.

A special device is provided for cutting out the lamp when the carbons are burnt out. A roller combined with a lever is fixed above the feeder, the roller pressing against the carbon. When the latter is consumed to a predetermined length, the roller slips over the top of it and jams the lever between the clutches so as to grip the carbon. Tests made by Prof. W. Wedding on the lamp have shown a consumption of 1·075 watts per candle. It is made in various patterns, for direct and alternating current, of which some are shown herewith.

Annual Dinner.—Some 70 members of the staff of the Electric and Ordnance Accessories Co., Ltd., foregathered in the Grosvenor Rooms of the Grand Hotel, Birmingham, on Saturday, 17th inst. The occasion was the first annual staff dinner and concert of the "Stelliters." Mr. R. F. Hall was in the chair, supported by vice-chairman Mr. D. C. Bate (sales manager), and Mr. J. R. Garner (works manager). After keenly discussing the dinner, a move was made to the adjoining room. The loyal toast was proposed from the chair and duly honoured. Later the toast "Success to Stellite," was proposed in a humorous speech by the vice-chairman. A musical programme followed.

Book Notices.—"Model Steam Turbines." By H. H. Harrison. *Model Engineer* Series, No. 23. London: Percival Marshall & Co. 6d. net.—This little work of a well-known series constitutes a practical handbook on the design and construction of model steam turbines. Formulæ for the calculation of the velocity and flow of steam through orifices and other data are given, and also complete details, together with many illustrations, for the designing of a De Laval steam turbine. For those interested in model construction it should prove very useful.

"How to Build a Petrol Motor." By James F. Gill. The Home Worker's Series, No. 3. London: Dawbarn & Ward, Ltd. 6d. net. This is another useful little handbook that has just been issued for the use of amateurs. A great deal of interesting information as to the construction of petrol motors is given, suitable either for bicycles or small boats, and we commend this to those who are desirous of constructing a small petrol engine.

"The Mechanical World Pocket Diary and Year Book for 1905," now in its eighteenth year of publication (by Emmott and Co., Manchester) has been considerably extended, trigonometrical and other tables of frequent utility having been added. Other additions are distributed through the body of the book, which retains its high position as one of the best of its class. We note that on p. 199 the mechanical equivalent of the heat unit is erroneously given as 772 ft.-lbs., and consequently all the derived values are also wrong. Further, on p. 219, "Bernardos" should read "Benardos."

"Willing's Press Guide." 1905. London: J. Willing, jun., Ltd. 1s.

"Leeds Association of Engineers: Annual Report for Year Ending October 31st, 1904." Secretary, Mr. R. Lupton, 1, Quarry Mount, Hyde Park, Leeds.

"Sheffield Corporation Electric Supply Department—Report on the Electrical Industry in the United States and Canada." By S. E. Fedden. 1904.

"Electric Lighting." Vol. I.—The Generating Plant." By Francis B. Crocker. Sixth edition. Revised. London: E. & F. N. Spon, Ltd. New York: D. van Nostrand Co. 12s. 6d. net.

"Proceedings of the Physical Society of London." December, 1904. Vol. XIX.—Part IV. London: Taylor & Francis.

"Maxwell's Theory and Wireless Telegraphy." Part I. "Maxwell's Theory and Hertzian Oscillations." By H. Poincaré, translated by F. K. Vreeland. Part II. "The Principles of Wireless Telegraphy." By F. K. Vreeland. London: Archibald Constable & Co., Ltd. 10s. 6d. net.

"Fortschritte der Elektrotechnik." Edited by Dr. Karl Strecker. Part I. 1904. Berlin: Julius Springer. M. 7.

Catalogues and Lists.—The Electrical Co., Ltd., has issued several new leaflets: No. 107, relating to their Tumbler switches and wood blocks, and No. 108, dealing with the Royal switches; No. 110, relating to wall sockets and plugs; No. 111, on ceiling roses and fuseboards; No. 112, on ideal candle fittings; and No. 113, containing a reprinted article on "Draw-out Carriage" high tension switchboard.

The Pfluger Accumulator Works, of 39, Victoria Street, S.W., has sent us a show-sheet, giving half-tone illustrations of some large installations of their batteries.

The Gilbert Arc Lamp Co., Ltd., of Chingford, has published a 10-p. pamphlet, the contents being a reprint of a report prepared by Mr. S. L. Pearce, the chief electrical engineer of Manchester, for the Special Street Mains Sub-committee of the Corporation, on the alterations which had been made in the street lighting of Manchester. Several arc lamps of different types were employed, the new Gilbert type giving great satisfaction. A number of comparative curves of gas *v* electric lighting are given demonstrating the superiority of the latter.

The publication department of the British Thomson-Houston Co., Ltd., of Rugby, is making heroic efforts to keep the B.T.H.-Edison incandescent lamps before the attention of the public. An artistic poster has been prepared, and it is posted in the carriages and on the platforms of the Central London Railway, while it is also in distribution among sellers of the lamps. Another effort consists of a picture post-card, "The Traveller's Return," which depicts the arrival at home of an Esquimau, with a box of B.T.H. lamps, "made in Rugby," for the "long night's use."

The British Thomson-Houston Co.'s latest new pamphlet (No. 177) describes their rheostatic controllers and resistances.

We have received from Messrs. J. S. Henry, Ltd., of Old Street, E.C., a leaflet containing a reprint of Press remarks respecting their wooden electric fittings, of which we gave illustrations in our special "Electric Fittings" issue.

We have received as usual a copy of the *Chemical Trade Journal* hanging calendar for next year, with monthly sheets.

Messrs. Falk, Stadelmann & Co., Ltd., of Farringdon Road, E.C., have issued list No. 216 supplementary to their telephone catalogue, containing particulars of further reductions in the prices of their telephones.

A circular (No. 107) has been received from Messrs. E. F. Moy, Ltd., describing briefly their switch fuses, in watertight cast-iron cases, for pressures up to 500 volts.

Messrs. Kramos, Ltd., of Locksbrook Engineering Works, Bath, are circulating a wall show-sheet containing illustrations of their high speed electric drills, resistance pieces, starters, lifting blocks, reduction gear, &c.

Electrical Winding Plant.—We are informed by a correspondent that the electrical winding plant lately installed by Messrs. A. Hirst & Son, electrical engineers, Dewsbury, for the New Sharlston Collieries Co., Ltd., has proved very satisfactory and fulfilled every condition expected of it. The motor is of the four-pole series type, and the starting switch is in a flame-light cast-iron case, and has carbon contacts, which are very easily renewed, and the starting lever is also used to reverse the motor. The machinery is fitted up with a powerful emergency brake on the armature shaft, which is capable of pulling up the motor at full speed. The winding drum is also provided with a foot brake, which is the one most used in winding coal. The motor will lift a weight of three tons a distance of 400 yds. in 45 sec. and after a very severe testing for a period of eight hours with various loads by the company's electrical engineer, Mr. John Bentham, the motor armature, field coils, commutator and bearings, &c., were quite cold. The motor is capable of working up to 180 E.H.P. at a pressure of 500 volts, and great credit is due to Messrs. A. Hirst & Son for the workman-like way in which the work has been carried out, as it is the largest electric winding plant installed by them so far.

Electric Lighting Co. Fined.—Last week the St. James' and Pall Mall Electric Light Co., Carnaby Street, Regent Street, was summoned at Marlborough Street Police-court for permitting water heated to 170° F. to flow into the public sewer. The summonses, 20 in number, covering several dates, were taken on behalf of the London County Council. Mr. Morse, for the defendants, stated that £600 had been spent in efforts to mitigate the trouble, which arose from the fact that the works must always be kept going. They had succeeded in cooling the flow now, and there would be no recurrence. The magistrate said that the defendants had to work under considerable disadvantages, and under the circumstances a fine of £5 on one summons, a nominal penalty of 1s. on the other 19, and £21 costs would meet the justice of the case.

Electric Coal-Cutters in Natal.—The *Times* in the course of some references to the coal trade of Natal, says that electrical coal-cutters, 13 in all, were employed in two collieries during 1903, and undercut 168,360 tons, or 24 per cent. of the colony's total output. This year has seen compressed air coal-cutters installed in three additional collieries.

London Coliseum.—On Thursday last week, on the invitation of the proprietors, we attended a demonstration of the capabilities of the elaborate machinery with which the stage is equipped. The principal event was a horse-race on the outermost of the three revolving stages; it was curious to see the horses galloping for all they were worth, while proceeding at the rate of, perhaps, a mile an hour. Probably no other theatre exists in which the aid of electricity has been availed of to an equal extent.

Trade Announcements.—Messrs. Shippey Brothers announce that they have disposed of their interest in the leases and goodwill of the "Central Motor-Car Emporium," also the American Motor-Car Agency, as carried on by them for the past two years at 117 and 118, Long Acre, to the "Central Motor-Car Co., Ltd.," of 18, Billiter Street, E.C., who have secured the sole British rights in the Ford motor-car for sale in the United Kingdom. Messrs. Shippey Brothers intend to extend their "wholesale and export trade" in the sale of American motor tires, Gordon batteries, non-skid tire bands, and other motor-car accessories at their City Stores, 13 and 14, King Street, Cheapside, London, E.C.

Mr. H. V. Kramer has formed a new company known as Kramos Ltd., Bath, which is taking over the entire business of the late Bath Electric Manufacturing Co., Ltd., of Locksbrook Engineering Works, Bath.

Messrs. Werner, Pfleiderer & Perkins, Ltd., have removed their head offices to Westwood Works, Peterborough.

Bankruptcy Proceedings.—At a recent sitting of the London Bankruptcy Court, Alfred James Hollington, electrical engineer, Barslay Oval, Woodford Green, and late of 37, Walbrook, E.C., attended before Mr. Registrar Hope for public examination upon accounts showing gross liabilities, £741 (unsecured £301), and assets book debts for £192, to which no value is attached. Replying to Mr. G. W. Chapman, the debtor stated that in June, 1896, he was taken into partnership by his then employer, in the business of wholesale electrical stores carried on at 29, Bush Lane, Cannon Street, E.C. He contributed £1,000 as capital, which money was left him by his father. That partnership expired at the end of three years, and witness retired on receipt of £900. He invested that sum shortly afterwards in J. D. F. Andrews, Ltd., an electrical engineering company, and acted as director until the company failed in December, 1900, and he lost his £900. Then, in March, 1901, he commenced an electrical engineers' supply stores business at 37, Walbrook, and in the following December he purchased the stock and effects of a similar business in the same building at the price of £130. Being in financial difficulties in December, 1903, he ceased trading, and subsequently realised his remaining stock, effects, and book debts, the proceeds being paid away to creditors and in expenses. At present he was in employment at a weekly salary of £2 and commission. Witness attributed his failure to bad debts and loss in the trading during the last 12 months of the period. The examination was concluded.

The application of Max Margowski, merchant, 13 and 14, Abchurch Lane, E.C., for an order of discharge came before Mr. Registrar Brougham, at the London Bankruptcy Court, on December 16th. Mr. G. W. Chapman, Official Receiver, reported that the bankrupt failed in November, 1903. Mr. F. S. Salaman, the trustee, had admitted claims amounting to £8,163 10s. 3d., and a further £640 would probably be allowed, whilst the estate had so far only realised £1 0s. 1d. The bankrupt—born in Germany, but a naturalised American—came to England in the autumn of 1892, and had since been engaged in sundry promotions and financial undertakings, in which he had lost large sums of money. He attributed

his failure to such losses, and to the general stagnation in financial business owing to the late war. In 1895 the bankrupt became connected with the Apostoloff Automatic Telephone Syndicate, which had a nominal capital of £10,000. He had stated that he found the working capital of £3,500, and was managing director of the syndicate. In 1897, the concern was reconstructed as the Automatic Telephone Co., Ltd., when the nominal capital became £100,000 in 5s. shares. The bankrupt, as vendor, appeared to have had a large number of shares, and, in fact, he included 59,330 in his marriage settlement made in November, 1899. This company was, in turn, dissolved in January, 1903, and the Automatic Telephone Co. (1903) Ltd., was formed, having the same capital of £100,000 divided into shares of 2s. 6d. each. That company had also gone into liquidation since the bankruptcy, and it was understood that the transactions of the bankrupt in connection with it were now being investigated. There were other companies in which the bankrupt had been interested, and in connection with which he had suffered losses. One only of his promotions appeared to have been successful so far as he was concerned, and in that he appeared to have got rid of his shares before the company went into liquidation, at a profit of over £20,000. As offences against the Act the Official Receiver alleged were (1) insufficiency of assets to pay 10s. in the £ to the creditors; and (2) bringing on the bankruptcy by rash and hazardous speculations. Mr. P. M. Crawcour Hart, on behalf of the trustee, opposed the application on the grounds (1) that the bankrupt had been guilty of fraud in connection with his dealings with shares in the Automatic Telephone Co., Ltd.; (2) that he had destroyed the books and documents affecting or relating to his property and affairs; (3) that he had made, or had been privy to making a false entry in a book relating to his property or affairs, viz., the share ledger of the Automatic Telephone Co., Ltd.; (4) that he had, with intent to defraud his creditors, made a gift, delivery, or transfer to, or charge on, his property, or some part thereof, to Mrs. Dora Margowski; (5) that he had incurred debts to the extent of £20 and upwards, without disclosing the fact that he was an undischarged bankrupt; (6) failure to deliver up to his trustee part of his property, viz., a patent for improved electrical fans; and (7) a material omission in his statement of affairs, viz., the said patent. The learned Registrar held that the trustee must more clearly define his charges by giving dates, &c., and he offered to adjourn the hearing with the object of enabling that to be done, the cost of the adjournment to be defrayed by the trustee. Dr. Counsel, on behalf of the applicant, consenting to those terms, the hearing was adjourned to the end of January next.

The public examination was held on Wednesday last week, before Mr. Registrar Gifford at the London Bankruptcy Court, of Walter Charles Bersey, late of Dacre House, Arundel Street, Strand. The statement of affairs showed total liabilities £4,371 (unsecured £3,363) and assets valued at £22 12s. In the course of his examination, which was conducted by Mr. C. A. Pope, the Assistant Receiver, the debtor stated that he was formerly employed as draughtsman by a firm of electrical engineers and invented parts of electric carriages. As vendor he assigned the inventions to the Universal Electric Carriage Co., Ltd., which was formed with a capital of £5,000, and he acted as managing director for about 18 months. That company was sold in August, 1896, for £10,000 in cash and shares; it was reconstructed, and, finally, as the Motor Manufacturing Co., went into liquidation. The London Electrical Cab Co., Ltd., was formed in November, 1896, to acquire, *inter alia*, a license for witness's inventions, which had been transferred to the Universal Electric Carriage Co., Ltd. The public subscribed £78,000, and there was a debenture issue of £15,000. He was appointed manager, at a salary of £300 per annum, and held the post for three years, when he resigned to become managing director. The Electrical Traffic Syndicate, Ltd., was formed in February, 1897, by witness and others, to purchase the English rights for carriages not running on rails. After that company was registered they gave a licence to the London Electrical Cab Co., Ltd. The Electrical Vehicle Syndicate, Ltd., was subsequently formed, with a capital of £25,000, and witness acted as a director for 12 months. Three years ago that company was absorbed by the Johnson-Lundell Electric Traction Co., Ltd. In 1899 witness took offices at 39, Victoria Street, S.W., where he carried on business as an electrical engineer. That business was formed into Bersey & Co., Ltd., but the company came to an end three or four months later. He also assisted in the promotion of the Protective Packing Paper Co., Ltd., which went into voluntary liquidation after an existence of two years; the Farmer Automobile Co., Ltd., the Garage Proprietary, Ltd., and the Lightning Detachable Wheel Syndicate, Ltd. He made profits of £500 over the flotation of the Universal Electric Carriage Co., Ltd., £3,500 over the Electrical Traffic Syndicate, Ltd., and the Electrical Vehical Syndicate, Ltd.; £300 or £400 over Bersey & Co., Ltd., and the Protective Packing Co., Ltd.; and £1,875 over the Farman Automobile Co., Ltd. A loss of £200 was made over the London Electrical Cab Co., Ltd.; one of £600 over the Garage Proprietary, Ltd., and one of £800 over the Automobile Manufacturing Co. Witness attributed his failure mainly to liability under guarantees to the extent of £775 given in 1898 to holders of shares in the Lightning Detachable Wheel Syndicate, Ltd.; to loss of about £950 on the purchase and re-sale in 1900 of shares in a photographic company; to loss of £850 on the sale in 1900 of an electrical engineering business, commenced by him at Willesden, to a company which went into liquidation; to law costs, and to interest on loans. The examination was ordered to be concluded.

At Burnley Bankruptcy Court, on December 15th, Walter Baker, member of the firm of Messrs. Robert Foster & Co., electrical engineers, of Adlington Street, Burnley, and of the Nelson Electrical Engineering Co., applied for his discharge from bankruptcy. The Official Receiver's report stated that the firms' estates had realised a first and final dividend of 2s. 1½d. in the £ on proofs amounting to £1,348 11s. 2d. An immediate discharge was granted conditionally on debtor having judgement for £50 entered against him; otherwise the discharge was suspended for two years.

Electric Car Building.—The *Times*, in a reference to the trade of Shropshire, remarks: "With new electric car works going into operation early in the year an improvement later is looked for."

Tramway Contracts.—Messrs. J. G. White & Co. have lately booked a number of very important contracts. The Belfast Corporation Tramways contract, of which we have already made mention, is divided into five sections, as follows:—

Section 1.—Permanent way, 26½ miles D.T., 2 miles S.T.; and 8 miles of double track, repairing and bonding only. The rails are B.S. Nos. 4 and 4c. The concrete bed is 7 in. thick. The special work amounts to £25,000. The paving is granite setts.

Section 2.—37 miles overhead construction, mostly span wire. The trolley wire is 4/0 S.W.G.

Section 3.—Cables, comprising feeders, telephone and test cables for the above, the cables to be laid on the solid system in earthenware troughs, filled in with bitumen. The dielectric is vulcanised bitumen.

Section 4.—Comprises engines, dynamos, switchboard, three-phase condensing plant, &c. There are three steam dynamos, direct current, of 1,000 KW. each, and 160 revolutions per minute. There are two 250-KW. three-phase motor-generators; two 126-KW. three-phase motor generators. There is also a 25-ton crane.

Section 6.—Boiler house, containing superheaters, mechanical stokers, condensers, coal and ash conveying plant, and the usual piping. There are four boilers, working at a pressure of 170 lbs.

The Monte Video contract consists of 51 miles of permanent way, with the accompanying overhead construction. There are 100 cars. The power station will contain generating sets to the extent of 2,000 KW. The value of this contract, for which Messrs. White are engineers and contractors, exceeds £400,000.

Messrs. White have also secured the contract for the Mansfield and District Light Railways, Messrs. Bramwell & Harris being the consulting engineers. The value of this contract is £48,000.

LIGHTING AND POWER NOTES.

Bournemouth.—The B.C. recently met to consider the question of lighting the main roads by electricity on Sundays, and after what appears to have been a ridiculously lengthy discussion, the motion was referred back to the Lighting and Tramways Committees. We gather that the streets of Bournemouth are not lighted on Sundays. This state of affairs surely savours of pre-historic times. Such conditions are a disgrace to the borough.

The electric lighting company is applying for powers to extend its lighting area to several villages outside Bournemouth.

Bo'ness.—The T.C. has come to an agreement with the National Electric Construction Co., Ltd., of London, to supply consumers of the electric light with fittings on the hire-purchase system. The fittings can be purchased from the company at the original cost price, plus 12½ per cent., and less 2½ per cent. per annum for depreciation.

Broxburn.—On Tuesday evening the new electric light supply for Broxburn and Uphall was switched on, in presence of a large gathering who assembled at the power station. The installation has been carried out by Messrs. Drake & Gorham. About 2½ miles of cable have been laid, the supply being on the three-wire system. In the main thoroughfares arc lamps are erected with a total candle-power of 10,200. The streets of minor importance are lighted by Nernst lamps of a total of 5,125 C.P. Provision has been made for the future extension of the station, and with the view of supplying private consumers a prov. order has been applied for.

Burslem.—Sanction to raise a loan of £21,000 for electric light purposes, and £9,984 for the provision of a refuse destructor, has been forwarded to the T.C. by the L.G.B.

The T.C. has authorised the application for a prov. order enabling the Corporation to supply energy to Tunstall. The order will contain a clause giving the Tunstall U.D.C. the option of purchasing that part of the undertaking which is in its area at any time on six months' notice being given.

Continental Notes.—ITALY.—A franchise has been granted to utilise the water-power of the Tanaro River at Vallentino for the generation of electrical energy.

A syndicate has been formed in Leghorn for the establishment of an electric power station in the town.

SPAIN.—A central station has lately been completed and put in operation at Villamaritante (Valencia). Water-power is utilised, the plant comprising two horizontal turbines, each of 500 H.P., driving three-phase alternators and a 50-H.P. exciting set.

Dublin.—The Corporation met on the 16th inst. to discuss the electric light question, and after a prolonged debate, Mr. R. Hammond's proposal to take over the working of the undertaking was rejected.

The statement prepared by the town clerk, and considered at the meeting last Friday, shows that the total amount of loans sanctioned

by the L.G.B. for the electric lighting undertakings, is £392,747, made up of £87,547 for the old, and £305,200 for the new undertakings. An additional loan of £49,000 has been applied for, and to this must be added the sum of £60,000, recommended by Mr. Hammond, to cover all expenditure that may be necessary for plant extensions, contingencies, &c., making a total liability of £501,747, and deducting from this sum £49,794 repaid, a balance remains of £451,953. The revenue for the six months ended September 30th last, including public lighting, was £11,300; working expenses amounted to £9,000; the amount set aside, for this period, for sinking fund and interest, amounts to about £10,000—£8,000 on the Pigeon House Works, and £2,000 on the Fleet Street scheme. Adding this loss to the debit balance outstanding on previous years, the total loss on working to date reaches £45,368.

Edmonton.—The amendment under discussion, and which was adjourned for further consideration, on the 2nd inst. in regard to offers received from certain companies for the lighting of the town, was on the 16th inst. defeated, and a further amendment that the Council should agree to lease its powers to the North Metropolitan Co., subject to terms to be agreed upon, was adopted. It was stated that the company had previously offered better terms than they now proposed.

Epsom.—The U.D.C. has reduced the prices of energy for lighting from 6½d. to 5½d. per unit, and for arcs to 4d. per unit, discounts not to be allowed in future, as from January 1st next.

Falkirk.—The T.C. has resolved to write the tramway company, that it has been reported to it that arrangements have been made between the tramway company and the Scottish Central Electric Power Co., whereby the latter is to supply electrical power on favourable terms, and pointing out that the Central Power Co. is precluded from supplying energy for use within the burgh.

Glasgow.—Permission has been granted the Macdonald Turbine Co., Ltd., to test one of their turbines at the Port Dundas generating station.

The Sub-Committee of the Electricity Department has instructed the electrical engineer to prepare and submit a comparison of the total sums expended under the various heads of the capital accounts, the percentage which each item bears to the total expended, and the amount expended on each item per KW. of maximum supply of the Corporation's undertaking compares with those of Edinburgh.

The Electricity Committee, with reference to a proposal to abolish or modify the minimum annual charge of £2 to consumers, has recommended to the Corporation that it be not abolished, but that in all cases where a supply of energy is taken for lighting and power purposes by the same consumer, the total amount payable in respect of both supplies should be set off against the annual minimum charge, the arrangement to take effect as from the commencement of the present financial year.

Hipperholme.—The *London Gazette* for December 16th contains notice of the U.D.C.'s application for an electric lighting prov. order.

Houghton-le-Spring.—The U.D.C. has consented to receive representatives of the local E.L. Co., who will submit a scheme of electric lighting for the town.

India.—The Simla Municipality has under consideration a scheme for lighting the Town Hall and certain public roads electrically. An estimate of Rs. 22,000 has been prepared by Mr. Pook, electrical engineer, and has been approved by the Committee and submitted to the Punjab Government, with a request that the Imperial Government make a grant from the funds allotted for the Simla extension scheme to meet the initial outlay.

The Government of India has decided to appoint an electrical adviser, with headquarters at Calcutta. The above appointment will supersede that of electrical engineer to the Government of Bengal.

Lichfield.—Messrs. Foote & Milne, Ltd., have informed the T.C. that they intend applying for a prov. order for E.L. within the city.

London.—The Administrative County of London and and District Electric Power Co.'s Bill has just been lodged in the Private Bill Office, and is to come before Parliament in the ensuing session. The object of the Bill is to incorporate a company with a capital of £5,000,000, in 500,000 shares of £10 each. Messrs. J. H. Armstrong, L. C. Cunliffe and James Falconer are named as the first directors, while the subscribers include the names of Lord Armstrong, Sir George Taubman Goldie, Sir James Joicey and the Hon. W. J. Armstrong. The area of supply is to comprise the City of London, the City of Westminster, the boroughs of Kensington, Battersea, Chelsea, Fulham, Hammersmith, Hampstead, Holborn, Paddington, St. Marylebone, Wandsworth and Ealing; the urban districts of Acton, Brentford, Chiswick, Hampton, Hampton Wick, Heston and Isleworth, Southall, Norwood, Teddington and Twickenham; the boroughs of Croydon, Kingston-on-Thames and Richmond, with a number of urban district councils in Surrey, and also Bromley, Beckenham and Penge in Kent. The proposed area also includes Woolwich, West Ham, Ilford and Gravesend.

Marylebone.—The B.C. has resolved to oppose the applications of companies to Parliament for powers to supply electricity in its area. The chairman of the Electricity Supply Committee reminded the Council that it had purchased the Metropolitan E.S. Co.'s powers for the district, and now that same company was promoting a Bill which included Marylebone. The Central Electric Supply Co. had erected a large station in the district, they had no power to supply energy in its area, but they were also applying for such authority. It might be desirable or necessary for the Electricity Committee to have authority to supply energy to such local bodies as are authorised to use electricity.

Battersea.—A model pre-payment meter has been submitted to the B.C. by the B.T.H. Co., and been thoroughly tested and found satisfactory. It was decided that all the meters required for the Town Hall and the Workmen's Dwellings on the Latchmere estate be similar to this model.

Bermondsey.—The B.C. has resolved to supply the dock company with energy at the following terms:—Power, 2d. per unit up to 10,000 units per annum; 1½d. per unit for each unit in excess of 10,000 up to 20,000 per annum; 1¼d. per unit for each unit in excess of 20,000 up to 50,000; above 50,000 to be charged at 1¼d. per unit. Lighting, 3½d. per unit up to 30,000 units, any excess to be charged at 2d. per unit.

Kensington.—On Tuesday last the B.C. received a letter from the Kensington and Knightsbridge Electric Lighting Co., asking for permission to erect a Bastian mercury vapour electric lamp in one of the streets, to illustrate this new method of lighting. Permission was given to erect the lamp in Kensington Court.

Shoreditch.—The B.C. has resolved to purchase the following meters for use during the next four months:—52 5-ampere 240-volts, estimated cost £111, 64 10-ampere ditto, £152; 30 25-ampere ditto, £87.

Westminster.—The Works Committee of the Council has come to a working arrangement with the electric lighting companies, with regard to access to boxes and notice of works. In reference to the construction of boxes, the Westminster Electric Supply Corporation had appealed to the B. of T. against the Council's disapproval of boxes in Grosvenor Road and other places.

Stepney.—The Finance Committee of the B.C. reported having decided to apply to the L.C.C. for a further loan of £10,000, on account of the eastern extension of the electric lighting undertaking.

Maidstone.—The T.C. has decided to hire out arc lamps to tradesmen at 6s. per annum, including trimming and keeping in repair.

Energy is to be supplied to the works of Messrs. Foster, Clark and Co. at 1d. per unit, on an agreement for 21 years.

Mexico.—A new contract, to run for a period of ten years, has been arranged with the Mexican Light and Power Co. for the electric lighting of the City of Mexico. The number of large arc lamps, which at present is 987, is to be increased to 1,200, and must burn 4,000 hours per year. The new lamps will comprise 100 of 2,000 C.P. and 113 of 1,200 C.P.

Montrose.—The North of Scotland Electric Light and Power Co.'s works were last week inspected by the T.C. and a number of prominent citizens. The works have also been open for public inspection.

New Zealand.—The report of Mr. L. M. Hancock, M.I.E.E., based on an examination of the water powers of the colony, serves to give prominence to the remarkable possibilities of New Zealand as a manufacturing country. The report refers briefly to what has been accomplished in long-distance transmission in California; describes a lengthy tour of inspection, and summarises the best method of developing power in the most important areas. Altogether some 43 falls are mentioned, capable of giving powers of from 1,000 to 320,000 H.P., and in the aggregate giving 2¼ million horse-power. Many of the above localities are unsuitable for pioneer development on account of preliminary engineering difficulties and expense. The report concludes with an estimate for the development of Lake Coleridge in the Christchurch district. The proposal in this case is to install four 2,500-H.P. turbines, which represents only one-ninth of the total possible power. The cost of the scheme would be $760,000, or $1,160,000 when the whole scheme is carried through. The operating costs per H.P. per annum are estimated at $28 (the figures being based upon present American practice). Attention is called to the possibility of economical irrigation and drainage—it being pointed out that in three shallow lakes only, some 62,000 acres are submerged; also to the fact that the railway systems are quite accessible for electrification.

Ormskirk.—The B. of G. on December 15th decided to apply to the L.G.B. for a loan of £4,000 to cover the cost of installing the electric light at the Workhouse.

Rawtenstall.—At a recent meeting of the T.C. a communication was received from the B. of T., intimating that it would defer the question of revoking the prov. order for six months from the 1st inst.

St. Austell.—From a local source we learn that the electric light was switched on in the district on the 16th inst., after the lapse of over a year, when the old works closed down. A new generating station has been erected on the old site by the St. Austell E.L. and P. Co., recently formed with a capital of £10,000, and new machinery and mains put down.

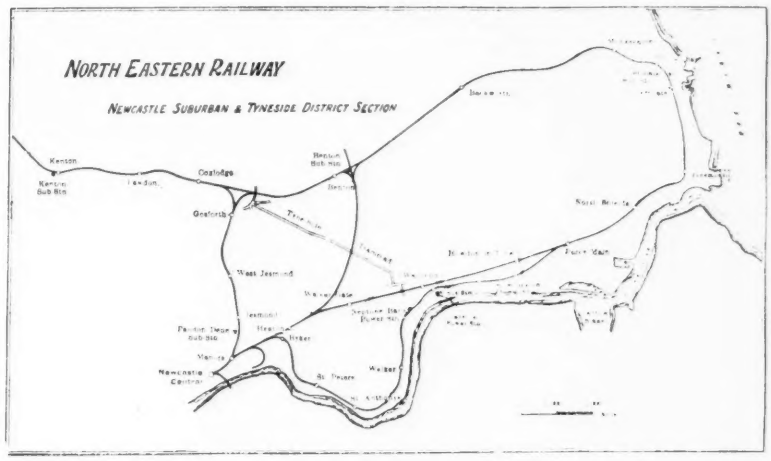
Slough.—The U.D.C. has decided to have the electric light installed at the Chalvey pumping station. The E.L. Co. will supply energy at 6d. per unit for the first 80 units per quarter, and 3d. per unit beyond.

Whitby.—The U.D.C. has resolved to borrow an additional sum of £1,500 for electric light purposes.

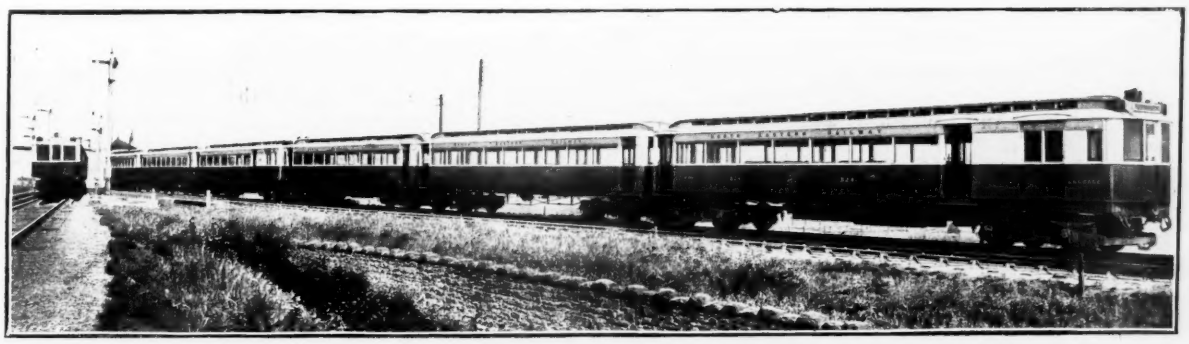
(*Continued on page* 1031)

ELECTRIFICATION OF THE NORTH-EASTERN RAILWAY.

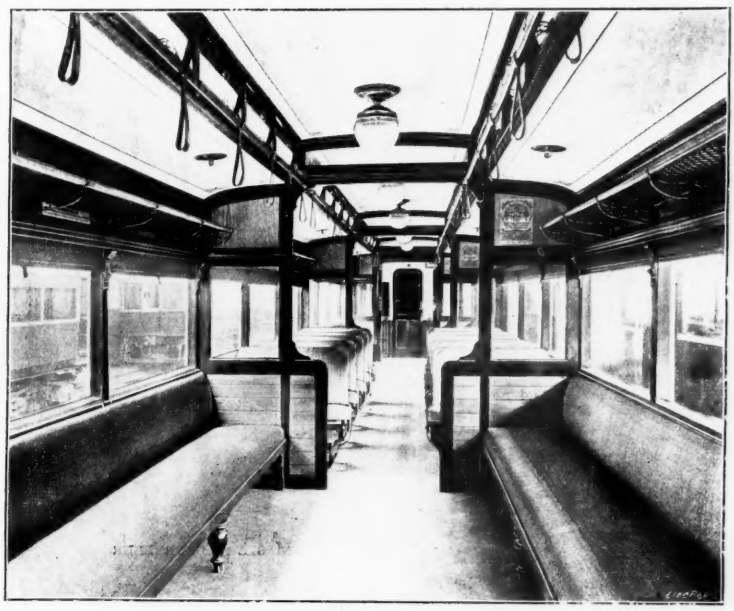
Since we described the Wallsend power station of the Newcastle-upon-Tyne Electric Supply Co. (Electrical Review, July 5th, 12th, 19th and August 2nd, 1901), which was then the only large power distribution undertaking actually at work, immense strides have been made in the development of the company's system. Practically all kinds of industrial operations are carried on with the aid of electrical power on Tyneside, besides lighting and traction, and since the year 1900 the power load has been multiplied about 15 times. One of the most important customers of the company is the North-Eastern Railway Co., whose suburban and riverside sections, embracing about 57 miles of track, have now for some months been operated by electric power.



Map of Electric Railways on Tyneside.



Six-coach Passenger Train.



Interior of Coach.

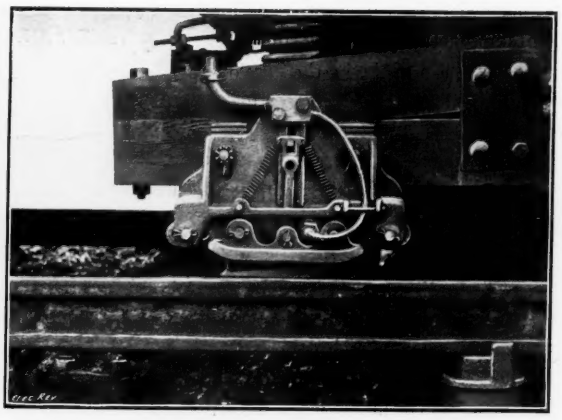
The following brief account of the electrification of this railway is taken mainly from the paper read by Messrs. C. H. Merz and W. McLellan at Cambridge, before Section G of the British Association, this year, and we are indebted for most of the illustrations to Mr. Merz, consulting engineer to the companies concerned.

The railway is operated on the third-rail system, with direct current supplied at a pressure of 600 volts; the electrical power is generated in the Newcastle-upon-Tyne Electric Supply Co.'s new station at Carville, in the form of three-phase alternating current at a pressure of 6,000 volts, and a frequency of 40 cycles per second, and is transmitted to five sub-stations, where it is converted to direct current. The return circuit is formed by the running rails.

The portion of the railway which has been electrified comprises three distinct lines, as shown on the accompanying map; these respectively serve the northern and eastern suburban districts of Jesmond, Gosforth, and Benton: the sea-coast line through Wallsend and North Shields: and the Riverside section, which is mainly used for goods traffic. The main line has also been electrically equipped as far as Benton, and the branch line from Gosforth to Kenton and Ponteland. The traffic on all these lines is normally very heavy, and in the summer time especially, the popular seaside resorts of Tynemouth and Whitley attract great numbers of Novocastrians,

many of whom, indeed, live at the seaside during the summer months and travel up to the city daily. The original steam service was carried on with trains running at intervals of one or two hours, and more frequently at the busier times; the electric service provides trains at intervals of about a quarter of an hour on all the passenger lines.

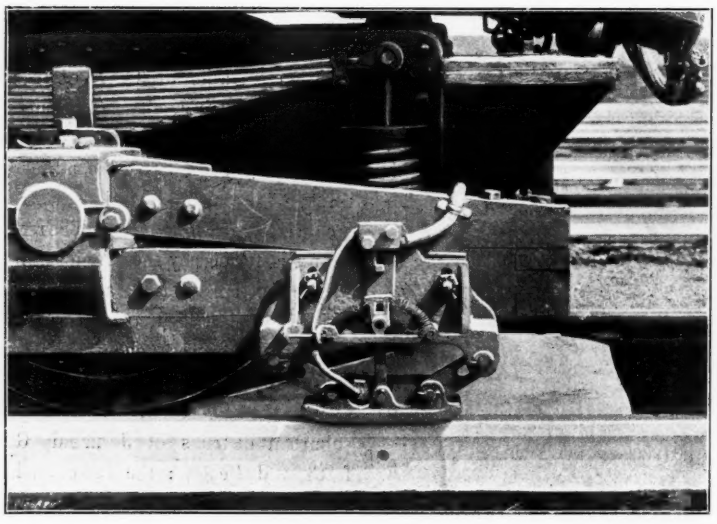
Contactors, with Covers Lowered.



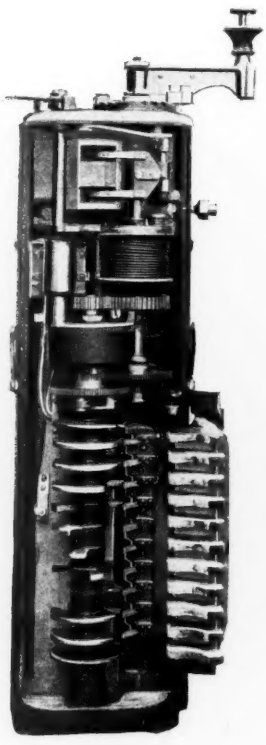
Contact Shoe, Raised.

In order to facilitate the economical adjustment of the seating capacity of the trains to the density of the traffic, whilst maintaining the normal frequency of service, the multiple-unit system of operation and control of the British Thomson-Houston Co. has been used throughout for the passenger service. An important advantage is also derived from the use of this system, in that the shunting of locomotives at the Central Station, which is the terminus for the suburban lines, is done away with, as the electric trains can be driven from either end; thus an important economy of time is effected. Thanks to the more rapid acceleration rendered possible by the use of electric traction, the average schedule speed has also been considerably increased on the suburban lines.

One of the electric trains is shown in our illustration on p. 1027. The coaches were built in the Railway Co.'s works



Contact Shoe, Lowered.



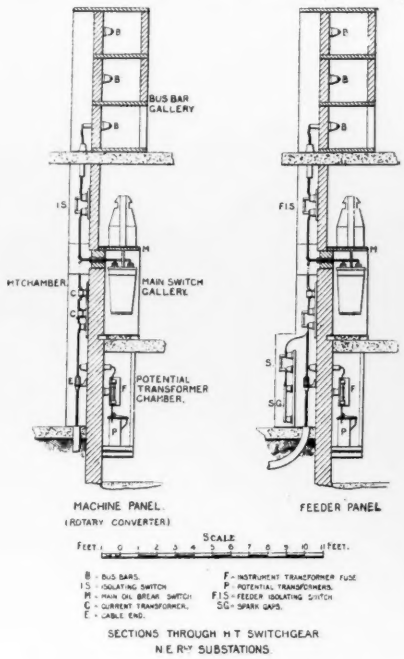
Master Controller.

at York, to the designs of Mr. Wilson Worsdell, chief mechanical engineer to the company, and are of the now usual corridor type, 55 ft. long, with accommodation for 70 passengers in a trailer and 68 in a motor coach. Each motor coach is equipped with two motors of 150 H.P. each, both mounted on the same bogie truck, and is capable of maintaining schedule time when hauling one trailer. The interior of one of the coaches is shown on the same page.

Contact is made with the conductor rail by means of sliding shoes, of which four are carried by each motor coach. The shoes are provided with means whereby they can either be lowered to rest on the third rail, or be held up out of the way, as shown in the illustrations on this page. From the shoes the current is conveyed through a main switch and fuse to a series of "contactors" fixed under the coach, and shown with covers removed in one of our views. These contactors take the place of the ordinary controller, cutting resistance out of or into circuit, and changing the connections of the motors in the usual way, and they are connected to a master controller, which is illustrated herewith. A similar controller is provided on each motor coach, and all of them are connected up to a 9-wire cable, which runs from end to end of the train, and actuates the contactors on all the motor coaches simultaneously. The trains are fitted with Westinghouse air brakes, and an electrically-driven air-compressor is provided on each motor coach. The wiring of the coaches has been carried out with a view to ensuring the maximum

of freedom from risk of fire due to leakage or short circuits. The main wiring of the motors from the contactors, and the control, lighting and compressor circuits, is run in grooved fire-proof insulated casing, with ample clearance between the wires ; the connections between the collector shoes and the main switch, on the other hand, not being under the direct control of the driver, are carried in solid-drawn steel piping $\frac{1}{8}$ in. thick, which is effectively earthed. All wires and cables are coated with fire-proof composition, and the under-side of the coach body is protected by a layer of sheet-steel backed with uralite.

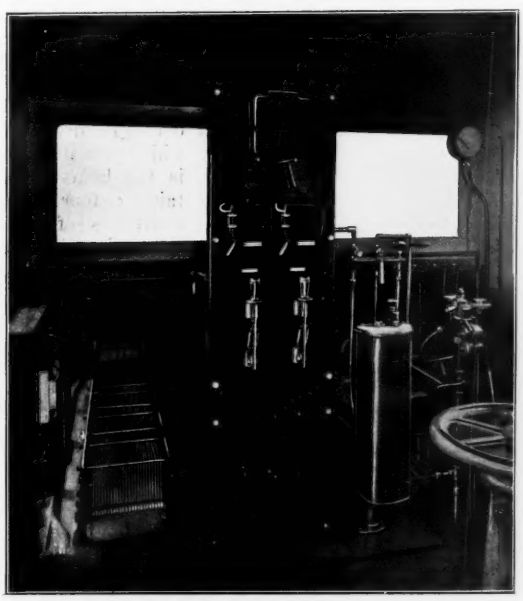
The conductor rail is of steel of high conductivity, weighing 80 lbs. per yard, and is carried on insulators fixed to the sleepers $19\frac{1}{4}$ in. from the gauge line of the nearest running rail. On the double track the live rails are fixed between the two tracks, but at junctions and crossings they are fixed on either side of the track, as may be found most convenient. Wherever there is foot traffic, as in the neighbourhood of stations, goods yards, &c., the live rail is guarded by creosoted boards bolted on either side of the rail against distance pieces. A view of the junction outside the Central Station is given below. The third rail is divided into isolated sections, with section switches at feeding points, signal cabins, &c., and the "up" and "down" line conductors can also be separated at these points. The fishplates of the running rails are specially designed to permit of the use of extra long flexible bonds.

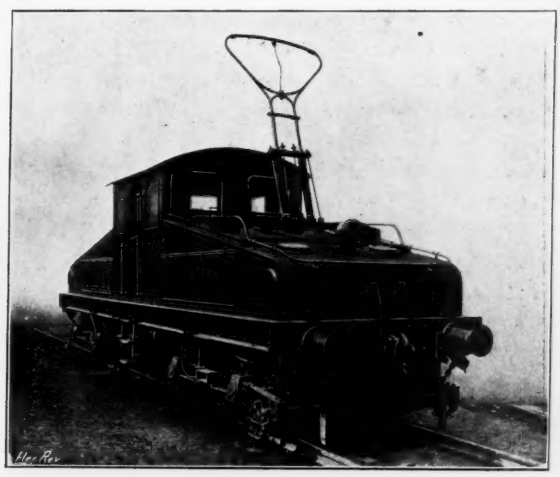

BUS BAR GALLERY
MAIN SWITCH GALLERY
POTENTIAL TRANSFORMER CHAMBER.
MACHINE PANEL. (ROTARY CONVERTER)
FEEDER PANEL
SCALE
FEET 0 1 2 3 4 5 6 7 8 9 10 11 FEET.
B - BUS BARS.
I.S. - ISOLATING SWITCH
M - MAIN OIL BREAK SWITCH.
C - CURRENT TRANSFORMER.
E - CABLE END.
F - INSTRUMENT TRANSFORMER FUSE.
P - POTENTIAL TRANSFORMERS.
F.I.S. - FEEDER ISOLATING SWITCH.
S.G. - SPARK GAPS.
SECTIONS THROUGH H.T. SWITCHGEAR N.E. Ry. SUBSTATIONS.

Junction at Central Station, Newcastle.

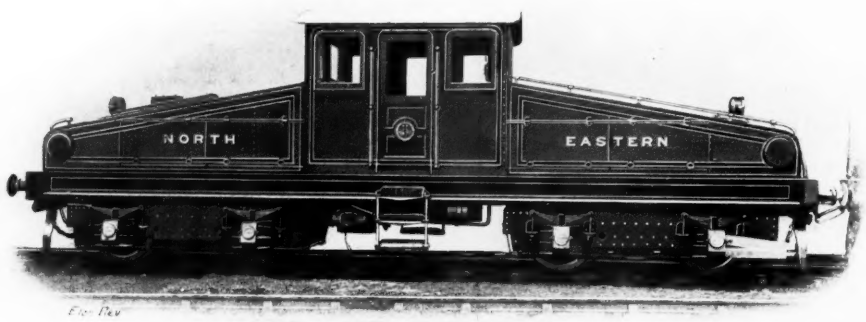
Considerable difficulty was met with in finding room for the live rails at complicated junctions, such as that outside the Central Station, where, owing to the arrangement of the station, all traffic, whether through or local, has to be dealt with as at a terminus, involving much shunting.

To deal with the goods traffic on the Riverside branch, locomotives have been provided, of which we give illustrations herewith. These are of the double bogie type, with central cab, and weigh, in running order, 50 tons. They were supplied by the British Thomson-Houston Co., Ltd., of Rugby, the contractors for the electrification of the railway, and are the largest ever built in this country. The locomotives were built by the Brush Electrical Engineering Co., Ltd, of Loughborough, and were equipped with G.E. 55 motors, one on each of the four axles of the bogie trucks. The leading dimensions are as follows :—Length overall, 37 ft. 11 in. ; length over cab, 9 ft. ; width overall, 8 ft. 8 in. ; height


Interior of Cab of Locomotive.


Locomotive with Bow Trolley.

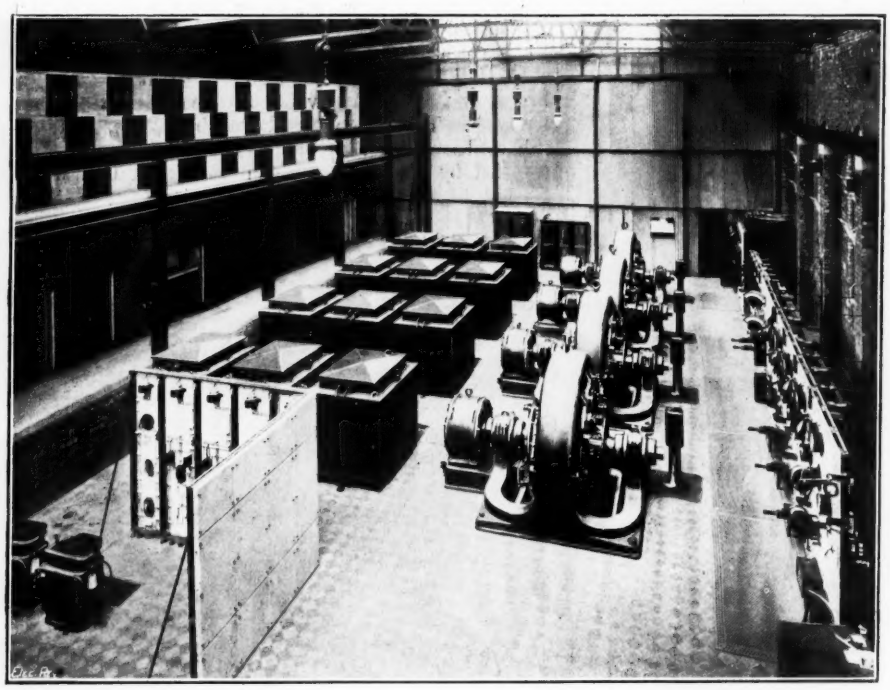
overall, 11 ft. 9 in.; centres of trucks, 20 ft. 6 in.; wheel base of each truck, 6 ft. 6 in.; diameter of wheels, 3 ft.; journals, 6 in. diameter × 10 in. long. The underframe is constructed of steel sections, ballasted with cast-iron blocks to make up the weight desired. The cab and end covers are of ⅛-in. steel plate. Arrangements are made for driving the locomotive from either end of the cab, which is therefore provided with master controller, brake valves, &c., in duplicate. The contactors, reversers and rheostats are fixed under the sloping ends, each pair of motors being provided with a separate equipment. The air brake is of the "quick-acting" Westinghouse type, and an electrically-driven air compressor is provided, giving a pressure of 90 lbs. per sq. in. The bogie trucks are built up of steel plate, strengthened with angles and gussets, and are provided with specially heavy brake gear, as much of the work of these locomotives will be done on steep grades. The motors drive through single reduction gear, with a ratio of 3·28 : 1, and are supported by nose suspension. The shoe beams are of oak, bolted to the axle boxes, the shoes being hung outside the wheel base. All the cables are covered with asbestos, and run in wood casing lined with uralite, or in steel tubing. Provision is made for coupling two locomotives together by means of the 9-wire couplers already mentioned in connection with the passenger trains, in addition to which main line and pump line couplers are provided, so that one man can operate both locomotives to deal with exceptionally heavy loads.



Side View of Goods Locomotive (Incomplete).

Normally, each locomotive is capable of hauling a 300-ton train on the level at a speed of 14 miles per hour, of starting with a train of 150 tons on a grade of 1 in 27 under all conditions of weather, and of running up this grade at a speed of 9 to 10 miles per hour, but they have considerably exceeded these requirements as regards both speed and tractive effort.

It will be noticed that the locomotives are fitted with sliding bow trolleys in addition to the shoes, to enable them to be used over sections equipped with overhead conductors. The trolleys are of special design, automatically reversing, according to the direction of travel of the locomotive, and can also be reversed and lowered from the cab by means of a hand-wheel actuating worm gear. The provision of these trolleys evidently indicates that the third rail alone cannot be adapted to meet all the conditions met with, and supports our contention as to the superiority of the overhead system compared with the third rail, even though in this case the power is supplied at low pressure.



Interior of Pandon Dene Sub-station.

The sub-stations, from which the railway is fed, are situated respectively at Pandon Dene (the site of the Supply Company's original generating station in Newcastle), Wallsend, Cullercoats, Benton, and Kenton, and have an aggregate capacity of 15,000 H.P. The one at Pandon Dene, which we illustrate, is the largest, containing four rotary converters of 1,100 H.P. each. The variations of load upon the railway sub-stations are extreme, and the converters, which were supplied by the British Westinghouse Co., Ltd., were specially designed to suit the conditions. Overload capacity is exceptionally important in this case, and the converters above mentioned are capable of dealing with overloads of 200 per cent., or over 3,000 H.P. each, for short periods. Each converter is provided with an induction motor for starting, and close to each set are the three transformers reducing the high pressure supply to suit the A.C. side of the converters. The high pressure A.C. switchgear occupies one of the side wells of the sub-station, while the direct current switchgear is on the opposite side. The former is all of the remote control type,

and was supplied by the British Westinghouse Co. The arrangement of this gear is shown in the cross-sections on p. 1029; the switchboard consists entirely of concrete, and is divided up into compartments so that each phase is entirely separated from the others. At the base of the board are brickwork chambers containing the potential transformers; on top of the latter are the high-pressure switches in compartments, surmounted by the motors which actuate them. Above these, again, on a gallery, are the compartments containing the high-pressure bus-bars. The arrangements are practically identical for both feeder and transformer panels. The high-pressure switchgear is controlled from the central switchboard, shown on the floor of the sub-station, together with the transformers for the induction motors.

(*To be concluded.*)

LIGHTING AND POWER NOTES.

(*Continued from page* 1026.)

South Wales.—The *Western Mail* states that the South Wales Electrical Power Distribution Co. is at present under contract to supply 10,400 H.P., they are in negotiation for supplying an additional 11,700 H.P., and have inquiries for 23,000 H.P. In the Cwmbran area the company are extending their mains to Abersychan, Crumlin, and Risca, and in the Pontypridd area to Caerphilly, Aber, Senghenydd, and Mardy. The latter extension will also serve collieries in the Aberdare district.

Sudbury.—The T.C. has issued a writ against the Empire E.L. and P. Co. to compel it to provide the guarantee it agreed to in connection with the electric lighting of the district. It was stated that the company had undertaken to give a guarantee of £2,000, but had not done so.

Walthamstow.—The T.C. has decided that the existing agreement with Mr. Enright as engineer to the electric light undertaking be terminated on 31st inst., Mr. Enright to receive commission on all works at present in hand. Messrs. J. and J. S. Enright have been appointed consulting engineers to the Council at a salary of £250 for three years as from January next.

Wentworth Woodhouse.—Referring to our note last week regarding Earl Fitzwilliam's private electric light installation, the battery of 111 cells was supplied by the Chloride Electrical Storage Co., and has a capacity of 840 ampere-hours.

West Bromwich.—Four of the employés of the Electricity Works staff have resigned in consequence of the recent action of the T.C. in not dealing with the allegations against the chairman of the committee of showing undue preference.

West Hartlepool.—A L.G.B. inquiry was held on the 13th inst. into the application of the Corporation to borrow, among other items, the sum of £13,861 for electric lighting. It was stated by the opposition that there had been excess expenditure over previous loans; and the inspector stated that the L.G.B. objected to loans being expended before they were sanctioned, and also to excess loans, and he would make a note of what had been said. The president of the Hartlepool Ratepayers' Association also spoke in opposition.

Willesden.—At a recent meeting of the U.D.C., the E.L. Committee recommended the purchase of a site for a future generating station, at a cost of £3,200.

An offer of the North Metropolitan Power Supply Co. to repay 100 gns. in respect of the services of the electrical engineer from February 12th to September 30th was accepted. After consideration the Committee decided not to adopt a flat-rate in lieu of, or as an alternative to, the maximum demand system.

TRAMWAY AND RAILWAY NOTES.

Ashton and Stalybridge.—The public of Ashton and Stalybridge are showing impatience at the continuance of the deadlock which has arisen between the Ashton Corporation and the Stalybridge, Hyde, and Joint Tramway Board. Proposals and counter-proposals, with a view to some arrangement, have been submitted, but without result. At a meeting of the Stalybridge Council last week, Mr. Alderman Ridgard, chairman of the Tramway Board, said they had offered Ashton similar terms to those existing between Manchester and Ashton, but the offer had been rejected. Mr. Ridgard had even suggested that Mr. Boyle, chairman of the Manchester Tramways Committee, and Mr. McElroy, the Manchester Tramway manager, should be invited to assist in effecting an arrangement; but this, likewise, was unacceptable. The Ashton Tramways Committee, on the other hand, have proposed alternate running between Stalybridge and Ashton, and between Ashton and Dukinfield, and through cars from Mossley to Ashton, and Hyde to Ashton. It is by no means certain that even this suggestion will be acceptable to the parties concerned.

Belfast.—The British Electric Traction Co. recently sent in a communication stating that they would require an annual minimum of 150,000 units, and asked the Corporation to submit its price for the same, and also for each 1,000 units additional. They expected to require this about next May. The Committee instructed the chief clerk to inform the B.E.T. Co. that if they would apply again when the Committee was in a position to supply current to the Cavehill and Whitewell lines, the estimate would be given.

Birmingham.—It is stated in a local paper that an offer has been made to the Corporation to lay down an experimental line equipped on the Kingsland mechanical surface contact system.

Cardiff.—The members of the Tramways Committee recently paid a visit to the Roath power station, and, conducted by Mr. Arthur Ellis, the electrical engineer and manager, inspected the whole of the buildings and machinery. The new extensions for the reception of machinery, which are nearing completion, came under review, and it is expected that the machinery will be placed in position in the early part of next year.

Glasgow.—An electric car accident occurred on Friday, the 16th inst., at an early hour in the morning. A car was proceeding westwards along Govan Road at a fast speed, when the driver was suddenly taken ill and fell off the platform on to the roadway. The fact that the driver was not in his place was unobserved by the conductor until the car had almost reached Elder Street. Here there was a stationary car, but it was too late to avoid a collision. As soon as the driver was missed, the conductor rushed to the top of the car and withdrew the trolley from the overhead wire. This had the effect of reducing the impact, but withal the runaway car dashed into the stationary car, knocking it on to the footpath and badly damaging the rear platform. At the time of the collision a number of persons were in the stationary car, and some were in the act of leaving. Four were injured.

Greenock.—The Greenock and Port Glasgow Tramways Co. have agreed, at the request of the Greenock Corporation, to increase their minimum guaranteed annual consumption of electricity from 500,000 units to 600,000, and to pay for the additional number at 1¼d. per unit. The increase, which dates from August 1st last, is only of a temporary nature, and may be withdrawn in the event of Greenock or Port Glasgow asking the company to take the energy from them for the working of the tramways in either of these burghs. The Corporation has agreed to allow the company the use of spare conduits for new feeder cables at a rent of 3d. per yard per annum.

Huddersfield.—The tramway employés have agreed to an annual medical examination as to the senses of sight and hearing, on the understanding that the Committee will hear any appeal from the doctor's decision. The Committee has declined to undertake to find employment for any employé who may fail to pass the required examination, but is willing to consider his qualifications for any other position as a vacancy may arise.

The tramway is to be extended to Gosport Mills, Outlane, for the purpose of coal haulage, and an agreement, which will be in force for seven years, is to be entered into between the Corporation and Messrs. J. H. Sykes & Co.

India.—SIMLA.—An electric rack-railway scheme is projected to connect Annandale with the Mall.

Leeds.—It is stated that steam turbo sets are to be introduced at the power station for extensions to meet the tramway demand.

Liverpool.—The laying of the third rail necessary for the connection which is being made between the L. and Y. Railway and the Overhead Railway at Seaforth, Liverpool, is now being proceeded with. A length of special span work is being constructed for the Overhead Railway Co. by the Widnes Foundry Co. The connection will, it is believed, be ready for traffic by March, 1905. On this extension a new station is to be built, and the present Seaforth Sands Station of the Overhead Railway will be utilised for other purposes.

Manchester, Sale and Altrincham.—Preparations are being made for the construction of the important line of tramway which is to connect the town of Altrincham and the intervening districts of Timperley, Sale and Ashton-on-Mersey with Manchester. The line is already laid, and working, from the City, as far as Stretford, but difficulties, arising from the condition of the bridges, and other matters, have delayed the projected extension on the Cheshire side. These difficulties are now in course of being arranged, and it is expected that work upon the roads will begin in time for the opening of the new lines for traffic before midsummer.

Middlesex.—Sir Colin Moncrieff sat at Westminster on Monday as sole arbitrator for the purpose of determining a claim brought by the Hornsey Borough Council against the Middlesex County Council for the recovery of a sum of £2,000. It was stated that, in connection with the construction of the electric tramways in North London, the County Council required the Borough Council

to carry out certain alterations to a number of manholes to sewers. The plan proposed by the County Council was regarded by the Borough Council as a dangerous one, both to the sewer men and the traffic generally, and, accordingly, the Borough Council carried out the work itself, and now sought repayment of the cost from the Council. The arbitrator has to determine the amount to be paid by the County Council, and, after hearing expert evidence, he reserved his award.

Newcastle-on-Tyne.—The Tramways Committee has just published the report of its auditor, Mr. Thos. Bowden, embodying the revenue account for the half-year ending September 29th last. The expenditure is stated as follows:—To power, pumping, sub-station, and distribution expenses, £5,288; public street lighting, £269; general expenses, £8,541; traffic expenses, £36,924; maintenance, £16,401; total, £67,424. The receipts were:—Traffic, £100,194; receipts for car damage, £23; advertising, £139; public street lighting, £1,430; rents, £265; public buildings lighting, £127; sundry receipts, £61; total, £102,239. A surplus of £34,815 is thus left, and from this there are to be made the following deductions:—£16,806 for interest, and £14,596 for redemption, leaving a net credit balance of £3,413. The auditor states that this balance is subject to adjustments, as certain items should be debited to revenue account. He again draws attention to the fact that there is no depreciation fund beyond what is thus represented by the repayment of loans.

Paris.—A Reuter dispatch from Paris says that the Eighth Correctional Tribunal has delivered judgement in the case of the disaster which occurred at the Couronnes station, of the Paris Metropolitan Railway in August, 1903. The guard of the train and the station-master were each sentenced to a month's imprisonment under the First Offenders' Act, with 2,000 francs damages, while the motorman was ordered to pay a fine of 3,000 francs, and another guard one of 2,000 francs. The railway company is declared to be liable with regard to the claims arising out of the case.

Rochester.—Major Pringle, R.E., on behalf of the Board of Trade, on Tuesday inspected the first section of the Corporation tramways. This is the route along New Road, connecting Rochester with the existing tramways at Chatham, and the permanent way and overhead equipment have been constructed by Messrs. Dick, Kerr & Co. at the following prices:—Permanent way, £5,257; overhead equipment, £968. The tramways have been leased by Rochester Corporation to the Chatham Tramway Co., who have constructed a short length of tramway route to join the Rochester terminus. Mr. Rotter is the engineer for the Corporation.

Salford.—A new tramway route from Salford to Heaton Park was opened for traffic last week. The line runs from Great Cheetham Street, Salford, by an almost direct route to the Park. A new road was constructed through a portion of Broughton Park to connect the Salford lines with those of Manchester at the junction, Middleton Road and Bury Old Road. The cars proceed thence by way of Middleton Road to the Heaton Park main entrance. This route serves the residents of both Higher and Lower Broughton.

Southampton.—The Borough Council last week had a lengthy discussion on a resolution: "That it be an instruction to the Tramways Committee to immediately advertise for a properly qualified general manager of the tramway undertaking." An amendment: "That it having been stated that the Tramways Committee will bring up a report as to the appointment of a manager, the consideration of the matter be postponed till the next Council meeting," was carried by 28 votes to 13.

South Shields.—At a meeting of the Tramways Committee held on the 13th inst., the question of laying the tramways over the routes where the work may be proceeded with at once was discussed, and it was decided to recommend to the Council that contracts should be advertised for, for the carrying out of the work in Fowler Street and Westoe Lane, and other sections where it can be taken in hand without delay.

Stalybridge.—The Joint Tramways and Electricity Board recently resolved to purchase a motor-tower wagon, a water car fitted with rail-cleaners, a salt distributor, and a removable snow plough.

TELEGRAPH AND TELEPHONE NOTES.

Imports of Telegraph Cables.—Rather more activity has prevailed during recent months as regards the imports of foreign telegraph cables and apparatus connected therewith into this country. Thus the imports during November last attained a total of £8,258 as compared with £7,316 in the preceding month, and £5,782 in November, 1903. Notwithstanding this, however, the imports for the year, so far as it has gone, show a smaller total than was recorded a year ago, the value for the 11 months ending with November being given as £48,610 as contrasted with £55,981 in the corresponding 11 months of 1903.

Italian Telephones.—A company has just been formed at Vigevano, to be known as La Società Telefonica Vigevanese, to establish and work a telephone line between Mortare, Vigevano, Abbrategrasso and Milan.

Spanish Telegraphs.—There are now 30,000 kilometres of land telegraph lines and 3,290 kilometres of submarine cables controlled by the Spanish Post and Telegraph authorities. There are 1,588 telegraph offices in the country, which last year dealt with 3,456,000 messages.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
Paramaribo-Cayenne	July 18, 1904	
Swakopmund-Mossamedes (under repair)	Oct. 10, 1904	
Sitka-Valdez	Nov. 11, 1904	
Falmouth-Bilboa	Dec. 14, 1904	
Trinidad-Demerara (No. 2)	Dec. 18, 1904	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto-Barrios	July 28, 1902	
via Bhamo beyond Tingyuch	Oct. 15, 1904	
Kertch-Soutchoum	Sept. 27, 1904	
Rome-Pera	Dec. 13, 1904	Dec. 15

Wireless Telegraphy.—A correspondent of the *Times*, at New York, says that the De Forest Co. has established wireless communication from Kansas City to Cleveland, a distance of about 800 miles. "This is the longest overland wireless communication on record."

A telegram from a *Standard* correspondent, dated December 15th, states that no direct news from Port Arthur has been received here since the wireless telegraph station within the fortress was destroyed by the Japanese shells.

The Vienna correspondent to the *Standard* states that a contract was signed on 16th inst. between the Turkish Government and Messrs. Siemens & Halske for the erection of wireless telegraph stations in Rhodes and at Dernah, Tripoli.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—January 12th. The Public Health Committee is inviting tenders for an electric light installation (engine, dynamos, &c.) for the new Infectious Diseases Hospital, Purdysburn. Specifications (10s.) from the Town Clerk.

Belgium.—Tenders have just been invited by the municipal authorities of Charleroi for the supply and installation of the transformers and mains required in connection with the electric lighting of the town.

France.—December 28th. The French Post and Telegraph authorities in Paris are inviting tenders for the supply of eight lots of paper-insulated electric cables. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretaire d'Etat des Postes et des Telegraphes, Rue de Grenelle, Paris.

Great Western Railway.—January 3rd. Conductor rails, insulating supports, copper bonds, &c., for the electrical equipment of the Hammersmith and City Railway. See "Official Notices" December 9th.

Johannesburg.—January 26th. Vignoles rails, fish-plates, rails, bolts, nuts, &c. See "Official Notices" to-day.

Johannesburg.—December 27th. Transformer pillars and switchgear; also two 35-ton electric overhead travelling cranes, for the Municipal Council's electrical undertaking. See two "Official Notices" October 28th.

London.—January 16th. Tenders for a 750-KW. steam alternator with pipe connections, &c., for the South London Electric Supply Corporation, Ltd. See "Official Notices" to-day.

Neath.—December 28th. Alternating current watt-meters for the Corporation. See "Official Notices" December 16th.

Port Elizabeth.—January 16th. Water-tube boilers, 400-KW. turbo-dynamos, mains, battery and boosters, switchboard, crane, public lighting, meters, workshop equipments and other plant, &c., for the Electricity Supply Undertaking. See "Official Notices" December 16th.

Pudsey.—January 20th. Underground mains, junction boxes, switchboard, &c., for the Corporation See "Official Notices" December 16th.

Rochdale.—December 27th. Three-phase and continuous-current switchgear, for electricity works extensions. See "Official Notices" December 9th.

Roumania.—January 28th, 1905. Tenders are being invited by the municipal authorities of Guirgin for the concession for the electric lighting of the town.

Shanghai. — March 31st, 1905. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Spain.—January 10th. The Spanish Ministry of Public Works in Madrid is inviting tenders until January 10th for the construction and working during a period of 60 years of an electric tramway between Azcoitia and Zumaya (province of Guipuzcoa). Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Obras Publicas, Madrid.

Sunderland.—December 30th. Wooden cooling towers for the Electricity Department. See "Official Notices" Dec. 16th.

CLOSED.

Belgium.—Ten firms tendered for the supply of 239,000 metres of arc lamp carbons to the Belgian State Railway Authorities in Brussels last week, the lowest quotation being that of La Compagnie Francaise des Charbon pour l'Electricité, of Paris.

Blackpool. — The tender of Messrs. Morrison and Roebuck, of Birley Street, Blackpool, for installing the E.L. in the new sanatorium at that town, has been accepted by the Council.

Burslem.—The T.C. has accepted the following tenders for additions to the electricity plant, &c.

General Electric Co., Ltd., balancer and booster	£337
Dick, Kerr & Co., Ltd., engines and dynamos	1,863
Callender's Cable Co., cables	9,554

Chesterfield.—The T.C. has accepted the tender of Mr. A. C. Burnley, of 41, Coleman Street, E.C., for the right of advertising on the tramcars for three years at the price of £26 per car per annum; also the right to advertise on one side of the tickets for a minimum number of 1,000,000, at £10 per annum, and £5 for each subsequent 500,000.

Glasgow.—The following offers have been accepted in connection with the extension of the car system from Pollokshaws East to Giffnock:—

Cables, National Conduit & Cable Co., Ltd.
Conduits, Howard Conduit Co., Ltd.
Electric lamps, Edison & Swan United Electric Light Co., Ltd.

The Sub-committee of the Electricity Department of the T.C. has recommended for acceptance the following offers:—

Kelvin & James White, Ltd, for 200 5-ampere, 200 10-ampere, 50 20-ampere, 25 25-ampere, and 52 30-ampere indicators.
Reason Manufacturing Co., Ltd., for 100 5-ampere, 100 10-ampere, 50 20-ampere, 25 25-ampere, 25 30-ampere, 25 100-ampere, 10 150-ampere, 5 200-ampere, and 5 300-ampere indicators.

Great Yarmouth.—The T.C. has accepted the tender of Callender's Cable & Construction Co., Ltd., for the supply of E.L. cables, at £259.

Hackney.—The B.C. has accepted the following tenders in connection with the electric light undertaking:—

Carbons.—The General Electric Co., Ltd., 50,000 pairs, at £3 7s. per 1,000, 10,000 pairs, at £2 5s. per 1,000.
Coal Weighing Machine and Hopper.—Messrs. W. & T. Avery, £117.
Steel Work, Driving Gear, &c.—Babcock & Wilcox, £111 15s.
Arc Lamps.—Johnson & Phillips, 10 arc lamps and columns for Graham Road.

Llandudno.—The tender of the Hart Accumulator Co., Ltd., has been accepted by the U.D.C. for replacing the storage battery at its electricity works, with 256 of their standard lighting type cells, having a capacity of 450 ampere-hours.

London.—The Fire Brigade Committee of the London County Council has received the following tenders for the wiring and fittings at the new station in course of erection at the Isle of Dogs:—

Ward Brothers	(accepted)	£140 0	National Electric Construction Co.		£184 0
A. H. Marshall & Co.	..	167 0	Oliver Clarke & Co.		220 0
Durell & Co.	..	179 13	Tamplin & Makovski, Ltd. ..		245 0
W. H. Johnson ..	..	183 5	Donnison, Sillem & Co. ..		247 10
F. J. Coleby & Co. ..	..	197 0			

The Council has considered tenders from 49 firms for the supply and erection of seven cast-iron water-tanks at the Greenwich power station. The tenders ranged from £1,173 12s. to £2,847, and that of S. Russell & Sons, of Leicester, at the first mentioned amount is recommended for acceptance.

London.—Messrs. Watson & Co., of Victoria Street, S.W., have again secured the contract of the National Telephone Co., Ltd., for insulating compound.

Lowestoft.—Tenders for E.L. cables have been accepted by the T.C. as follows:—

Callender's Cable Co., feeders, £535 per 1,000 yds.
W. F. Dennis & Co., London, cables (1,500 yds.), at £23 per 100 yds.

Malta.—The Lancashire Dynamo and Motor Co., Ltd., has received an order from the Admiralty for the whole of the electrical equipment for Malta Dockyard, including boilers, engines, dynamos, motor-generators and motors, in accordance with the specification of Messrs. Preece & Cardew.

Southampton.—The Education Committee has accepted the tender of Messrs. Shalders & Davis, for installing the E.L. in the Portswood School, at £175.

Stepney.—The B.C. has received the following tenders for the supply and delivery of conduits, troughs and covers to December 31st, 1906:—

CONDUITS.

Henley's Telegraph Works Co., Ltd. (accepted) ..	£1,807 13 4
Siemens Bros. & Co., Ltd.	1,840 13 4
Albion Clay Co., Ltd.	1,910 16 10
J. Knowles & Co.	2,053 6 8
Doulton & Co. (informal)	—

TROUGHS AND COVERS.

Siemens Bros. & Co., Ltd. (accepted)	£1,235 13 4
" " alternative	1,310 13 4
Henley's Telegraph Works Co., Ltd.	1,301 13 4
" alternative ..	1,290 13 4
Doulton & Co.	1,353 0 0
J. Knowles & Co.	1,917 13 4

An order has been placed with Messrs. Babcock & Wilcox, Ltd., at £310, for another exhaust stack required in connection with the extension of the station.

Stoke-on-Trent.—The B.G. have accepted the tender of Messrs. Tutor & Meadows, of Hanley, for the extension of the electricity installation at the workhouse, at £452. 14 tenders were sent in, the amounts ranging from £237 to £574.

Wandsworth.—The following is a list of the tenders received by the Borough Council for the installation of electric lighting at the Council House:—

W. H. McKone & Co. (accepted)	£281 14		May Calder & Co.	£390 19	
James Wilson	295 0		A. White & Co.	400 0	
Lee & Warren	303 10		Ward Bros.	418 0	
Geo. Candler & Sons	313 0		Strode & Co.	425 0	
Ernest Probert & Co.	315 15		W. J. Fryer & Co.	431 8	
Bromley & Batstone	323 12		Wright, Methuen & Co. ..	433 17	
Wm. Wallace & Co., Ltd. ..	326 0		D. Hulett & Co., Ltd. ..	447 11	
Holmes & Cooper	333 10		Grundy & Coombe	460 0	
J. E. Spagnoletti & Co. ..	355 0		Alliance Electrical Co., Ltd.	495 5	
Jackson Bros.	359 8		Tamplin & Makovski, Ltd. ..	500 0	
The Salisbury Electrical Engineering Co.	370 0		W. S. Murrin	504 0	
Hemingway & Pritt	379 6		F. J. Coleby & Co.	525 0	
Hooper Neary & Co.	388 9		Davidson Bros.	540 0	
			Fred. Hayes	550 0	

The work is to be done to the specification of Mr. W. P. Adams, and under his supervision. The ventilation of the Council Chamber by means of an electric fan is to be carried out by Messrs. Matthews and Yates, at £77.

West Ham.—The Education Committee has accepted the tender, at £141, of Mr. J. T. Halsey for electric fire alarm gongs.

NOTES.

A Merry Christmas. — We take this opportunity of wishing all readers and friends of the ELECTRICAL REVIEW, a Merry Christmas. The year has not been one of the most satisfactory for some connected with electrical affairs, and no doubt it will be with less reluctance than usual that business will be laid aside, and the Christmas festivities allowed to take its place. There may be comfort for us at this season in the hopes that are entertained by some that things are beginning to improve. We trust that they are, and after the Christmas gatherings let us all return to our respective callings determined to put a greater zest into our efforts as far as practicable to *make* things improve, and to be ready for the awakening when it comes. Again, to all, a Merry Christmas!

Appointments Vacant.—In view of the large number of technical questions which arise from time to time for consideration by the Government of India, it is proposed to appoint an Electrical Adviser, who will not be prohibited from undertaking private work. The salary will be Rs. 1,000 rising to Rs. 1,600, and the official will rank as a superintending engineer of the Public Works Department. The headquarters of the Electrical Adviser will be in Calcutta: a telegraph inspector is required for the Postal and Telegraph Department of Southern Nigeria (£300).

Society of Engineers.—The fiftieth annual general meeting was held on 12th inst. at Westminster. Mr. Nicholas James West was elected President for 1905. The President announced that the following premiums had been awarded by the Council for papers read during the past session—viz., the President's gold medal to Mr. William Edward Storey for his paper on "Condensing Machinery"; a Society's premium of books to Mr. A. S. E. Ackermann for his paper on "British and American Coal-cutting Machines."

A Literary Genius in a Power House.—The *Daily Mail* is not usually remarkable for humour, but in its issue of the 12th inst. there appeared quite the most laughable—or, rather, ridiculous—article on a tramway power station that we have ever seen. Those of our readers who wish to see what preposterous nonsense can be written—aye, and *published* in a London paper!—should look it up. Who is this egregious "H. B.," or "J. B.," as he variously signs himself?

South African Notes.—*Hillarys (Natal).*—The *Natal Government Gazette* of November 15th gave notice of an application which is to be made, at the next session of the Legislative Assembly by Benjamin Hampton and W. W. Cato, of Durban, which will authorise and empower them to construct, lay down, and thereafter work a tramway, either by steam, oil, or electricity, starting from Hillarys station on the Natal main line to the boundary of the Bellair Estate, giving a length of six miles. Powers will also be included to contract for the supply of electric light and power, to residents in the districts served by the said tramway.

From our Durban Correspondent:—With reference to the note in the last issue of the Electrical Review regarding the scheme for electrifying the Springs-Randfontein section of the Central South African Railways for passenger traffic, the *Transvaal Leader* gives fuller details, from which we extract the following particulars:—

With a view to affording an increased and quickened train service which it may fairly be anticipated the passenger traffic of the future will demand, the Administration has been in communication with Messrs. Mordey & Dawbarn with the object of obtaining full information in regard to the proposal to adopt electric traction, and also with a view to coming to an arrangement for the carrying out of the work. In their report, Messrs. Mordey & Dawbarn state:—

"After an exhaustive consideration of the respective merits and demerits of the single-phase and three-phase systems, Mr. Dawbarn reports that the former is simpler, costs less in upkeep, and is superior in acceleration and average speed for a given maximum horse-power to the latter system. On the other hand, the single-phase system involves a higher first cost for the electrical equipment of each train, which, however, is more than compensated for by it requiring only one contact wire throughout the length of each track instead of two, as in the case of the three-phase system. Mr. Dawbarn has therefore no hesitation in coming to the conclusion that the single-phase is by far the better system for the Central South African Railways."

Capital outlay and working costs of present steam and proposed electric services.—Present steam service: Train miles per annum, 551,200; capital outlay, £167,500; working cost per train mile, 45·65d.; total working cost, £94,948; interest and sinking fund, 6 per cent. on £167,500, £10,050—£104,998. Electrical service: Train miles per annum, 651,860; capital outlay, £429,660; working cost per train mile, 26·78d.; total working cost, £44,805; interest and sinking fund, 6 per cent. on £430,000, £25,800—£70,605.

The working costs are only comparative. Many items, such as station attendance charges, capital charges on permanent way and stations, general management charges, &c., have been omitted, as they are common to both schemes. The electrical scheme lends itself to expansion to any desired extent, and as the scheme is increased, so will the relative saving be increased, as the capital charges will not increase *pro rata* with the increased service. Summary:—

STEAM SCHEME.—Annual Working Cost.

Working expenses as above for 551,200 train miles	£94,948
Capital charges..	10,050
Balance—gross profit..	98,342
	£203,340

Annual Revenue.

Passengers and parcels based on June, 1904	£203,340
	£203,340

ELECTRIC SCHEME.—Cost.

Working expenses as above for 651,860 train miles	£44,805
Electric supply for light and power stations	6,100
Capital charges	25,800
Balance—gross profit..	159,797
	£236,502

Revenue.

Passengers and parcels as above	£203,340
Add as result of improved service 10 per cent.	20,304
Electric energy for light and power at present cost	12,828
	£236,502

Note.—The foregoing results show that a direct saving of £60,000 per annum will be effected by the adoption of electric traction, or fully £40,000 per annum, without allowance for increased revenue due to an improved service amounting to nearly 20 per cent. increase in the train mileage and 29 per cent. reduction in the time occupied by each journey—that is, from 3 hours 10 minutes to 2 hours 15 minutes over the whole route length of 57·8 miles from Springs to Randfontein.

Mr. Dawbarn has stated that the existing suburban carriages could be converted for electric traction, which would effect a corresponding reduction in the capital outlay, while it is expected that the 20 locomotives which would be out of use by abandoning steam could mostly, and probably all, be employed on other sections of the line.

The following is a copy of a cablegram from Messrs. Mordey and Dawbarn, London, to C.S.A.R., Johannesburg, dated November 8th, 1904:—

"Satisfactory tender received Contractor Beardmore highest standing competent sub-contractors all British plant prices including new trucks £322,800 add railage £15,700 allow telegraph alterations £9,000 value coaches utilised minus trucks £75,200 fees contingencies £22,500 total £445,000 Compared our estimate contemplating cash £430,000 minimum half-yearly payments £25,000 commencing two years from order interest 4 per cent. accruing from end six months on £100,000 from end year on £200,000 from end 18 months on unpaid balance if repayment commence six months after order total contract £312,800 consulted Duncan."

South African Mines, a Johannesburg paper, in referring to the scheme, says:—"Lord Milner characterised this scheme at the Inter-Colonial Council meeting this week as 'excellent business,' and in view of the fact that the Government is relieved of the necessity of providing payment until after the work is completed, the likelihood is that the scheme will go through. If the results of the electric service, supposing it is provided, are as good as anticipated, the electrification of other sections of the system is sure to follow. The railway authorities have forecasted so much, more than once. Although, by the way, the firm with whom the provisional arrangement has been made, for the electrification of the Springs-Randfontein section is an English-American one, it has been arranged that British plant only shall be used, so that the scheme, if carried out as it is almost sure to be, will result in many big orders for plant going to British houses."

The Institution of Civil Engineers.—An address on "The Recent Visit to the United States and Canada," will be delivered by Sir W. H. White, K.C.B., Past-President, on Tuesday, January 10th, 1905, at 8 p.m. The address will be repeated on the following day, at 3.30 p.m. At the students' meeting on Friday, January 13th, 1905, at 8 p.m., Mr. James Swinburne will deliver a lecture entitled "Theory of Electricity and Magnetism."

Speed Limits: Tramcars v. Motor-Cars.—The Tramways and Light Railways Association has sent the following letter to the Board of Trade on this subject:—

The Council of the Tramways and Light Railways Association have instructed me to communicate to you their strong opinion that the speed limits on tramways should not be more stringent than the limit for motor-cars, and especially for motor-omnibuses on the same road.

They desire me respectfully to point out that under Sec. 9 of the Motor-Car Act, 1903, the limit for motor-cars is 20 miles an hour, unless (*a*) on the petition of the local authority, (*b*) by the order of the Local Government Board, a lower limit is enforced, and this limit can never be less than 10 miles an hour.

This enactment is a recognition by the Legislature of the obvious scientific fact that a higher speed is now practicable for road traffic, with due regard to the public safety, than was heretofore supposed to be desirable, and it affords a good reason for revising all previous bye-laws fixing the limit of speed on tramways.

The tramway owners are now, in many cases and at vast expense, furnishing a wider road and smoother track for the use of competitive motor-omnibuses, which are not subject to the same limitations of speed. There is no scientific reason why, except perhaps on very sharp gradients, tramcars should not safely be allowed to run as fast as motors. There are, indeed, many practical reasons to the contrary. The tramway owners are always ascertainable and always responsible in case of accidents; they only run on a defined track, and that, generally, at a good distance from the footway. The danger of the roads is much increased by the practical necessity for motor-cars to swerve aside in order to pass tramcars creeping along within the legal limits.

My Council respectfully suggest that the Board of Trade should notify that, as a general rule, they will adopt the limit of 20 miles prescribed by the Legislature in the case of motor-cars, and that they propose, subject to any exceptions that may be necessary in special cases, to modify their regulations in this sense. This would leave unaffected any bye-law of local authorities prescribing less speed, but, when sanctioning fresh bye-laws, the Board of Trade would, it is assumed, have regard to the same considerations.

The Board of Trade are, of course, aware that, in the case of tramways, as in the case of motor-cars, the fact that the car is running within the legal limit is no answer to a claim in case of accident. The tramway owners would still have every reason for restraining their drivers from recklessness or carelessness.

My Council believe that this matter urgently demands the attention of the Board of Trade, in the interests both of the travelling public and of the privat or municipal capital embarked in tramways.

Ernest Benedict, *Secretary.*

December 2nd, 1904.

Birmingham Electric Club.—The first meeting of the members of the Birmingham and District Electric Club took place on 10th inst., at the Colonnade Hotel, Mr. J. J. Inniss presiding. In his presidential address Mr. Inniss pointed to the great possibilities of the club, and said it was essential that the standard of the aspirations of the members should be raised as high as possible, having regard to the advance, educationally, which has taken place during recent years in Birmingham. As the club membership included all departments of the electrical profession, he hoped that the papers to be read at the meetings would be as practicable as possible. Like other professions, that of the electrical engineer was somewhat crowded in some of its departments, but there were satisfactory openings for good men, such as designers of machines. In this connection he stated that he knew of more than one electrical firm which had to go abroad for its chief designers. There were also great possibilities in other directions.

Electricity in Mines.—At a meeting of the Executive Council of the Mining Association of Great Britain, held at the Westminster Palace Hotel last week, a report from the Advisory Representative Committee appointed to deal with this matter was presented, setting out that the suggested rules for the installation and use of electricity in mines had been amended and considerably reduced in number, and that the Committee had reason to believe that they would be accepted in their amended and condensed form, or something very nearly approaching it. The amendments made were set out in detail in the report, which was adopted, and the draft suggested rules approved in the form suggested by the Committee. It was further decided that if they could be finally agreed to on the lines suggested, the law clerk should forward copies to the members of the Association in the various districts, with a recommendation from the Executive Council that they be accepted in that form.

The Yarmouth Rails.—Mr. G. S. Pawle writes to the *Pall Mall Gazette* on the question of the Yarmouth rail contract, and replies as a "serious free importer" to the letter of another correspondent who denounced the Town Council, for saving £450 for the ratepayers by accepting a tender of 900 tons of steel rails from Belgium, for electric trams. He says:—

"In the first place, steel rails are raw material for a tramway system. The Yarmouth working man requires the best and cheapest system of locomotion. The Yarmouth ratepayer hopes that the municipal trams will pay the interest on the money expended on them, and does not feel justified in being handicapped to the extent of at least £18 per annum in perpetuity, being interest on £450 at 4 per cent. so that the work may be given to people in the Midlands at his expense. Your correspondent says a 10 per cent. duty on

these rails from Belgium would have put the tenders on a par. Would it? Had the British ironmaster been protected by such a duty, is it reasonable to suppose his lowest tender would have been only 10 per cent. above Belgium? Of course, it could not be. Protection, if adopted at all, must be protection all round, involving a general rise in prices and a general increase in wages. In that case, the Belgian tender at £4 15s., plus 9s. 6d. duty, would still be equal to our home producer's price of £5 4s. 6d. per ton, whereas the home producer under protection would naturally require a higher price for his output. It will, therefore, be seen that the Belgian tender would have to be accepted all the same, the only difference being that Yarmouth ratepayers would have to pay £450 more for their rails, which sum the British Government would receive less the cost of collection. In that event, the Yarmouth ratepayers and the Midland Counties' working men would both have a serious cause of complaint. The home producer would very naturally demand such a duty as would keep Belgian steel effectually out of our home market. If Mr. Crickmay believes in the 'hereditary rights of local occupation,' it is only necessary for the Government to insist that any corporation or individual requiring steel rails should be made to accept only British steel made by British labour in Great Britain. I fear a good deal of the pig-iron required in the process of making steel rails comes from abroad, so in any case it seems very difficult, let alone very expensive, trying to keep out the foreigner. If any British Government decides to raise revenue by imposing import duties, this is another question altogether. A free importer would say it was a grossly extravagant way of doing it!"

London County Council.—At the meeting on Tuesday, the Finance Committee reminded the Council of the sanction given to the borrowing by the Marylebone Borough Council of £433,800 for electric lighting purposes, and stated that the Borough Council had asked for an amendment of the sanction so as to provide that the first instalment of principal might be repaid at the expiration of three years from the date of borrowing. On the recommendation of the Committee, the Council resolved to accede to the request, in so far as the sum of £340,405 was concerned, which was repayable in 42 years. It was also decided to advance £100,000 of that sum to the Borough Council, one half at once, and the other half at a time convenient to the County Council. Other electric lighting loans which were approved, were £7,515 to the St. Pancras Council, and £1,255 to the Shoreditch Council.

The Highways Committee reported that Mr. J. A. Baker, at the request of the Council, had visited New York to attend the opening of the rapid-transit subways in that city in response to the invitation forwarded by the Board of Rapid Transit Railroad Commissioners. The actual inauguration was delayed and Mr. Baker was unable to remain, but he was afforded facilities for examining in detail all parts of the work. A report had been prepared on the subject, and on the recommendation of the Committee, it was decided to place copies on sale at 1s. 6d. each.

The decision which was arrived at in May of last year to adopt the overhead trolley system for the tramways along Archway Road to the county boundary was referred to by the Highways Committee, who stated that the lines would form part of a through route to Finchley and Whetstone. The Committee was in communication with the Middlesex County Council with a view to a temporary arrangement being made for working the lines in connection with the Middlesex light railways, pending the reconstruction of the portion of the Council's northern tramways, with which the Archway Road lines would ultimately be connected. It was hoped to submit a report on the question soon after the Christmas vacation. In the meantime, it was decided to forward the necessary plans to the Board of Trade and the Islington Borough Council, the latter of which was prepared, subject to contain conditions, to give consent to the use of the overhead system.

Benevolent Fund for the Electrical Industry.—The following letter comes to hand as we go to press:—

"Whilst fully sympathising with the efforts of Mr. Justus Eck and his friends to promote a benevolent fund for the benefit of necessitous members of the electrical industry, may I be permitted to point out that there is already in existence a benevolent fund in connection with the Institution of Electrical Engineers for the purpose of assisting members, or the families of members, in temporary or permanent need.

"Efforts are now being made to improve the position of this fund, and I shall be pleased to forward the rules to any member who may desire to have a copy.—Yours faithfully,

"G. C. Lloyd,

"*Hon. Secretary to the Benevolent Fund of the I.E.E.*"

We mentioned the existence of this fund in our reference to Mr. Eck's letter last week, and pointed out that its scope was limited to members of the Institution.

Tramways and Light Railways Association.—The official circular for December contains the discussion which followed Mr. A. N. Connett's "Notes on Permanent Way," also Mr. Stephen Sellon's paper on "Running Powers." The circular also contains a copy of the model description of overhead electrical equipment as drawn up by the Board of Trade. On Friday last, 16th inst., the members visited the power houses of the Great Northern and City, and City and South London Railways; and on Friday, January 13th, 1905, Mr. Henry M. Sayers will deliver a lecture on "Overhead Equipment" in the lecture room of the Society of Arts at 8 p.m. A visit, in January, to the works of the Central London Railway has also been arranged.

Papers and Lectures.—The Dublin Section of the Institution of Electrical Engineers at their December meeting considered a paper entitled "A Description of Electric Light and Power Schemes in New York, with Special Reference to the Waterside Station of the New York Edison Co.," by Mr. P. S. Sheardown. It was decided to adjourn the discussion until the next meeting of the Section on January 12th.

A paper was given at the Bradford Technical College last week, by Mr. Edwin Kenyon, on "The Transmission of Power by Ropes."

A lecture entitled "Notes on Electric Tramways" was delivered at a meeting of the Dundee Society of Experimental Engineers by Mr. James S. Shepherd, of the Dundee tramway department, last week.

Mr. James Dalrymple, the new manager of the Glasgow Corporation Tramways, lectured on Friday evening, December 16th, on the city car system.

Peter Pilkington, Ltd.—Mr. Arthur Whittaker, of 3, York Street, Manchester, has been appointed receiver and manager of the assets and undertaking of Peter Pilkington, Ltd., of Dowry Ironworks, Bamber Bridge, near Preston. The business will be continued as hitherto. A meeting of creditors will be duly convened. Orders given out should bear Mr. Whittaker's signature.

A "Simplex" Clock.—The Simplex Steel and Conduit Co., Ltd., of Westinghouse Buildings, Strand, pass the compliments of the season in a singularly attractive and useful way. A large-figured timepiece in a leather case is the form it takes; and as it is particularly strong and robust in build it will probably check off the time for many a year to come. May the enterprise and success of the Simplex Co. equally long continue.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*]

Central Station Engineers.—The Leigh (Lancs.) T.C. has, by 16 votes to 6, rejected a proposal that the salary of the new electrical engineer should be £200 a year instead of £250. The late engineer (Mr. D. M. Kinghorn) was paid £180 per annum.

The Gas and Electricity Committee of Stafford T.C. has recommended the Corporation to increase the salary of the electrical engineer, Mr. R. E. Meade, from £150 to £175 per annum.

The officials and workmen of the Farnworth U.D.C.'s electricity and tramways departments have presented a smoker's cabinet and a slide rule to Mr. J. D. Pember, chief engineer, on his departure for Dartford, Kent, to become chief engineer of the electricity works there.

Mr. C. A. Cowell recently sent in his resignation of the position of electrical engineer to the Hanley Corporation, but the Committee is anxious that he should remain. He has, however, asked it to withdraw its recommendation to the Corporation to that effect.

Mr. E. Zoller, of the Croydon electricity works, has been appointed shift engineer at Fulham.

Owing to the action of the Electricity Committee of Elland U.D.C. in appointing a jointer as assistant engineer, Mr. Heron, electrical engineer, has resigned, as he "refuses to accept the risk and responsibility, not to say the impossibility of working the station under the conditions the Committee wish to impose upon me." The Committee's object is economy.

Radcliffe U.D.C. has appointed Mr. Henry Wilkinson as switchboard attendant at the electricity works.

Mr. H. R. Mills, charge engineer at the Beckenham supply station, was presented with a handsome marble clock by the engineer and staff of the works on the occasion of his marriage with Miss E. Barnett, of Forest Hill, on December 21st.

Tramway Officials.—A long discussion took place at the T.C. meeting in regard to the fixing of the salary of Mr. Dalrymple, the new manager of the Glasgow tramways. Mr. Dallas moved that the salary be £850, rising by £50 until it reached £1,000. He maintained that if they had advertised the post at £850, they would have had an unlimited number of suitable applicants. There were only five municipalities in Britain which paid a larger salary than that suggested now. The convener of the Tramways Committee, in moving that the salary be £1,000, held that that sum was not too much to pay to the manager of the Glasgow tramways, which were the biggest and most successfully managed system in Great Britain. The manager of the London system, which was about three-quarters of the extent of Glasgow tramways, got £1,500. In Liverpool, which was two-thirds the size, the salary was £1,200, to rise to £1,500 in January, 1905. In Birmingham, where the system was one-third of the size of that of Glasgow, the salary was £1,500, and in Leeds it was £1,000. These figures should convince them that £850 was absolutely the lowest salary paid to any general manager in charge of such a system. After discussion, the salary was fixed at £1,000 by 31 votes to 29.

Mr. H. H. Heaybeard, late of Messrs. R. W. Blackwell & Co., has been appointed outside equipment assistant under the Hull Corporation tramways department.

Mr. T. Lewis, late permanent-way inspector at Leicester, has been appointed permanent-way inspector at Belfast. Any further appointments to the salaried staff at Belfast will be brought before the committee after January 1st.

General.—Mr. S. Woodfield has resigned his position with the British Thomson-Houston Co, Ltd., in order to join the staff of Messrs. J. G. White & Co.

Mr. Vincent S. Allpress, M.I.C.E., notifies that the partnership between himself and Mr. W. H. Massey has been dissolved by mutual consent. Mr. Allpress will continue to practise at 25, Queen Anne's Gate, Westminster, S.W., as a consulting electrical and mechanical engineer.

Lord Kelvin has accepted the nomination for the presidency of the Faraday Society, in succession to Sir J. W. Swan, F.R.S.

NEW COMPANIES REGISTERED.

Automatic Electric Co., Ltd. (82,897).—This company was registered on December 16th, with a capital of £1,000 in £1 shares, to carry on the business of suppliers of light, heat and power, carriers of passengers and goods, manufacturers of telephones, telegraphs, phonographs, dynamos, accumulators, lamps, and all apparatus used in connection with the generation, accumulation, distribution, supply and employment of electricity, &c. The first subscribers (each with one share) are:—D. L. Chalmers, Vron House, Vron near Llangollen, chartered accountant; C. G. T. Driffield, Woodcroft, Prescot, near Liverpool, secretary; C. E. Rockley, 15, Brompton Avenue, Egremont, Cheshire, secretary; J. B. Leatherbarrow, Windsor Hotel, Benson Street, Liverpool, engineer; J. Lamb, 6, Alfred Road, Birkenhead, articled clerk; H. H. Woodward, 6, Valley Road, Anfield, Liverpool, book-keeper; and D. Hogg, 37, Aberdeen Street, Liverpool, clerk. No initial public issue. D. L. Chalmers is the first managing director; remuneration as fixed by the board. Registered office, 12, St. John's Lane, Liverpool.

ELECTRIC TRAMWAY ACCOUNTS.

West Ham Municipal Tramways.

The following tabulated results relate to the West Ham tramway system, in which the electrical sections are municipally worked, and the horse-car sections are operated by the North Metropolitan Tramways Co., prior to reconstruction. It will be seen that a high average revenue per car-mile is earned, and that working expenses represent a good average figure, the consumption of energy and its first cost being exceedingly moderate.

Judging by the respective revenues per route-mile for the electrical section only, and for the combined sections (the latter giving 17 per cent. less), we should imagine that the installation of the more profitable and popular system throughout will not long be delayed. On the half-year's working a balance, after meeting financial charges, of £6,686 remained, from which the reserve fund benefited to the extent of £2,686, the remainder being voted in relief of the rates. The tramways manager is Mr. H. E. Blain.

General Statement for Half-Year ended September 30th, 1904.

Electrical Section—	
Length of route	8 miles 60 chains
Total length of track	15 miles 5 chains
Number of cars in use (daily average)	29
Car-miles run	561,832
Passengers carried	7,632,604
Capital expenditure to date	£196,538
Traffic receipts	£27,260
Total receipts	£27,748
Working expenses	£16,588
Gross profit	£11,160
Electric and Horse Tramways, 12-mile route—	
Total receipts	£30,748
Working expenses (approximately)	£17,350
Gross profit	£13,398
Electrical Section—	
Income per car-mile	11·85d.
Working expenses per car-mile	7·08d.
Cost of energy per car-mile	1·42d.
Average fare charged per mile	·56d.
Average fare per passenger	·55d.
Revenue per mile of route	£3,083
Expenditure per mile of route	£1,843
Electrical and Horse Tramways—	
Revenue per mile of route	£2,562
Expenditure per mile of route	£1,446
Electrical Section—	
Total units used	498,608
Units used per car-mile	·89
Percentage of working expenses to receipts	60

Profit Statement.

Interest on loans	£4,549
Sinking fund	2,163
Reserve fund	2,686
To borough rate	4,000
Gross profit	£13,398

CITY NOTES.

India-Rubber, Gutta-Percha and Telegraph Works Co.

Major Leonard Darwin presided at the meeting held at the offices, 106, Cannon Street, E.C., on Tuesday last. In moving the adoption of the report, which appeared in our issue of December 16th, Major Darwin said that he was presiding because their chairman was at present in Japan. Mr. J. Y. Buchanan, one of the extraordinary directors, had been transferred to the ordinary board. In dealing with the accounts, he regretted having to move the sanctioning of a dividend which, though a fair one as dividends go, was about one-half of the amount that this company had been accustomed to distribute among its shareholders during the last 26 years, and half of the average of the rate divided annually since 1868. The board debated as to whether they should pay the usual 10 per cent., in spite of the small available balance shown in the profit and loss account, but although fully realising the inconvenience to the shareholders, they decided that it would be in the best interest of the company not to do so. Several reasons induced them to adopt this resolution, and so far as he could without disclosing trade secrets, he would endeavour to show that the decision was a prudent one. The present price of raw material was very high; raw india-rubber, amongst others, had reached quite a phenomenal price, some 30 per cent. higher than the highest it had ever reached before, and twice the price at which it had been sold at a fairly recent date. In a market of this nature, and in its present state, it was quite impossible to predict the future, but if this high price should continue and show some steadiness, they would doubtless be permitted by their competitors to charge higher prices for their productions. The trade had, some 10 days ago, agreed to advance selling prices. This advance would not, however, suffice if the price of the raw material should not show a considerable lowering in the current year. The development of a new line of business was progressing, and the inevitable expenses connected with such development, though diminishing, were still very heavy, and had made serious inroads into such reserves as were applicable to this purpose, and also on the year's revenue. Moreover, increased vigilance and great prudence were necessary on the boards, partly on account of the ever-increasing, though only too often ephemeral, competition to which the company's productions were subjected. If one looked round for the competitors of 30 years ago, few were to be found. The competitors of 20 years ago were naturally more, but the number who had gone under in the struggle was difficult to enumerate. The local taxation was another point which industrial undertakings should always have in view, and reference should be made to it on every occasion, in the hope that frequent repetition might lead at least to the curbing of an extravagance which was undermining the manufacturing interests of the country. So far as the question affected this company, they hoped they had reached the limit in West Ham, where the Silvertown works were situated. The rating there had reached 10s. 2d. in the £. As a rate of about that amount had been charged for some years, one could form some idea of its effect, and by the nearest estimate they could make, they believed that the establishment of their works in the district brought a contribution of no less than between £45,000 and £50,000 per annum to the Corporation, or, in other words, an amount about equal to the average earnings distributed among the shareholders. If that reasoning was correct, it would appear that the shareholders of an industrial undertaking such as theirs, contributed 50 per cent. of what should be their earnings, to local taxation. If the district in which their works were situated, were rated as many Midland districts were at 5s. in the £, the dividend would have been at the rate of 15 per cent., instead of the 10 per cent. which they had been receiving. The statement as to rating did not, of course, apply particularly to the result shown in the accounts for this year, but it was an illustration of the difficulties under which they traded. Through an average of years, their net profit had not greatly increased, but the amount of business they had been obliged to do in order to maintain this position, had had to be increased at least fourfold. They could not allow themselves to think they could always pick out the good things and leave the bad, they could only hope to keep a good average, and this the board believed had been the case for many years. In the question of extravagance against prudence, the board would certainly counsel the latter, but they believed that their actions proved that experiments must be made, and new things tried, on occasions at a loss, and at considerable risk, but that in this they must not go beyond their means. They were developing a new business which might prove profitable, but on the other hand, might involve loss; this development was within their means, and the board hoped for success, or they would not undertake it. In the meantime, however, the board was of opinion that under the present circumstances it was unwise to ask the shareholders to sanction the payment of a larger dividend than 5 per cent. for the year. He then formally moved:—"That the report and accounts for the

year ended September 30th last be received and adopted," with a distribution of a dividend of 5s. per share.

Mr. Henderson seconded the motion, and in doing so wished to emphasise what the chairman had said on the subject of the reduced dividend. He believed that the board were absolutely unanimous, and did not see their way to pay anything more than they had recommended. They hoped strongly that the business of the company would enable them to pay the ordinary dividend next year; but it was only a hope, and no one could prophesy what was going to happen.

Mr. Henry Cabus-Wilson said that he had sent out a circular to shareholders, not drawn up in hostility to the directors, but to obtain an opinion on the desirability of the equalisation of dividends. He read from a number of the letters received in response to the circular, showing that the fall in the dividend was a severe hardship to many shareholders. By the articles of association the reserve fund had been built up for equalisation purposes. The dividend had been maintained at 10 per cent. in previous years when the profits had not been sufficient to pay it, the directors having drawn upon the floating balance of undivided profits in order to equalise it. As a consequence of this the company had attained a high reputation as a steady dividend-paying concern. The shareholders felt that they had a claim upon the directors to equalise the dividend for bad years. The reduced dividend meant a heavy fall in the value of the shares, and if this policy were persisted in it might lead to permanent reduction in that value. The course of the directors was not justifiable unless there was absolute necessity for it, and the onus of proof lay with the directors. Was it not possible to pay the usual dividend by drawing upon the large floating balance?

Another shareholder asked whether it would be possible to give them some indication of the nature of the new business. If it was against the policy of the company, or the good of the company, he would not press the question.

Mr. Bryans thought it was a great mistake to reduce the dividend on the facts before them. The average profits for the last five years, omitting this one, had been over £55,000, and this year they had a most extraordinary reduction to only £11,343. Indeed, that profit would have actually been a loss if the same amount had been written off for depreciation, as was written off last year. They ought to have some explanation of that. It might be that last year they had written off more than was necessary, or else that this year they had not written off enough. They had £65,970 to dispose of, and the board proposed that they should only dispose of £12,500! Was the company doing badly, or was it doing well? If £37,500 were paid to the shareholders, there would still be £28,000 odd to carry over. Surely that was enough, seeing that they had £450,000 in the reserve fund as well. The position gave one the unpleasant feeling that there was something behind that they did not know. Why had the £100,000 debentures been issued during the year?

Mr. Reed asked whether the reserve fund was available, or was it wholly or principally employed in the business. He imagined that the directors found themselves put into a tight place by the very fact that they had not that money available to put their hands upon.

The Chairman, in reply, said that when the directors decided to pay a 5 per cent. dividend, they knew that they were inflicting a considerable hardship upon shareholders; but shareholders' discontent was not greater than that of the directors. Everybody who knew anything about commercial affairs would agree that the rate of interest had been falling during recent years. Almost all companies had found that either their interest had fallen, or else their capital value had risen. The directors had been very much impressed with the request to pay a uniform rate of interest. On the whole, they had been fairly successful, but if a uniform rate of interest was to be maintained, it could only be done by an increase in the value of the concern. The value of a concern could only be increased by putting more money into it, and the money that they had put into it had been taken out of the profits of the company in past years. They had paid a lower dividend for the past year, and the money that they might have paid away in dividends had been placed in their own buildings in solid assets. A reserve fund, which took the form of buildings and other capital expenditure at the works, had been in the past an absolute necessity if they were to pay a uniform rate of interest. If they had had that £450,000 in extra shares instead of reserve, the dividend would be about one-half what they were at present. The shareholders were not in such a good position as the directors to judge what was really for the interests of the company. No one would have been better pleased than the directors to increase the dividend. But they felt that it was their bounden duty to stick to the decision announced in the report. Paying a dividend out of reserve was a perfectly legitimate thing to do in an ordinary way, but what they had to consider was, was it a wise thing to do under the present circumstances? As their reserve was in the main represented by machinery, buildings, and other assets which they could not sell, they might have had to borrow money to pay a dividend out of reserve. They had to consider whether they ought to at present run the risk of having to raise more funds. In regard to the rise of raw material, it had never been so great before, and only those who had actual dealings with a manufacturing company were aware of its extent; the cost of raw material to the company this year, compared to last, was about £80,000 to £90,000 more. There was no standing still in the fierce commercial struggle. They might have adopted a policy of standing still, and then they could conceivably have paid a 10 per cent. dividend, but if they had adopted that policy, they would have certainly been drifting into the position of a second-class company and the permanent payment of lower dividends. He saw no permanent reason to expect a change which would make them pay less dividends in the future. It was with very deep and sincere regret, and with the most respectful consideration of every word that had been uttered at the meeting, that they felt that they must adhere, in the shareholders' interests, to their advice that only 5 per cent. should be sanctioned. Those who invested in manufacturing companies, of course, took manufacturing risks.

The resolution to adopt the report and pay the dividend recommended was carried *nem. con.*

British Thomson-Houston Co.

For some reason or other not mentioned in the statement of the board, the report of this company for the 12 months ended March 30th, 1904, has only just appeared, and the annual meeting was held last week—that is, between eight and nine months after the completion of the year. In 1903 the meeting to consider the March report was held towards the end of July, which is a more reasonable date. The number of shareholders in the company is not large, but, none the less, our readers would be justified in wondering what the cause of the delay is. So far as the year's operations are concerned, there is a gross profit of £182,570 shown; but when general charges, technical and patent department expenses, sales, branch offices and store-room expenses, discounts allowed, interest on loans and debentures are provided for, there remains a net profit of £55,713. This is dealt with in the following manner:—

To depreciation	£19,756
To amount written off goodwill, patents and licences ..	4,054
To amount written off suspense account	30,000
Balance carried to balance-sheet	11,903
	£55,713

The balance of £11,903 is added to £4,471, the amount brought forward from March, 1903, making £16,374 available. Of this sum, £13,552 is devoted to the payment of dividend on the preference shares to February 5th, 1904, thus leaving £2,822 at the credit of profit and loss account.

The paid-up capital is £400,000 in ordinary, and £400,000 in 4 per cent. preference shares with £212,795—4½ per cent. debenture stock, and loans to the tune of £205,512. The General Electric Co., of New York, appears on the liabilities side of the balance-sheet for £307,666.

The cost of the Rugby factory, land, &c., appears as £420,683, apparatus, &c., finished and in process of manufacture, £266,223; shares and debentures are held in lighting and traction companies, amounting to £461,803; goodwill, patents, and licences stand at £76,924. The sundry debtors, retention moneys and other outstanding accounts are £440,296, and the sundry creditors and retentions, &c., £219,584. There is £87,580 in cash at the bank and on loan at short notice.

At the annual meeting held at 83, Cannon Street, E.C., on December 15th, Mr. W. A. McArthur, M.P., who presided, moved the adoption of the following report:—

Works at Rugby.—The additions to the factory and office buildings, which, in the last annual report, were stated to be under construction, have been completed.

The number of hands employed, excluding the office staff, amounted at March 31st to 1,704, and has since increased.

North-Eastern Railway.—The electrification of certain of the local lines of this railway in the Newcastle district has been completed, and they have been for some time in satisfactory operation.

The Underground Electric Railways Co. of London, Ltd.—During the period under review the company secured the contracts for the electric equipment of the trains of this company, the system of control being the multiple unit system, similar to that furnished to the Central London Railway, the Great Northern and City Railway, and the North-Eastern Railway, with satisfactory results.

Curtis Turbine.—The manufacture of Curtis steam turbines has progressed satisfactorily. Those in operation are giving excellent results, and have excited much favourable comment.

Shares and Debentures in Lighting and Traction Companies.—The directors believe that the company has good value in the enterprises in which it has investments.

The directors have followed their usual practice in providing for depreciation of buildings and plant, patents and stock in hand, besides making reserves sufficient in their opinion to cover risks in connection with bad debts, depreciation of shares held by the company, and for other contingencies. The profits, after deducting general and technical expenses, discounts and interest, amount to £55,713 8s. 1d., which has been applied as shown in the balance-sheet and profit and loss account, leaving a balance of £2,821 16s. 2d. to be carried to the next year's accounts. As shown by the balance-sheet, the excess costs of manufacture incidental to the establishment of the manufacturing business of the company to date amount to £63,926 15s. 6d. Of this amount £20,000 is now written off, and further amounts will be written off until finally disposed of. The board deeply regrets the loss by death of one of its members—Sir Thomas Thompson, Bart. It is not for the present contemplated to fill the vacancy thus created. The retiring directors are Messrs. E. A. Carolan, C. A. Coffin, O. H. Smith and S. Kocherthaler, who, being eligible, offer themselves for re-election.

The Chairman said that the board had, as usual, adopted a fairly drastic method of valuation in their treatment of the accounts, which gave, as they stood, a very fair representation of the actual value of the property. Their investments had been treated in the same way, and they had also, with the consent and acquiescence of their principal shareholders, adopted the policy of making very large repayments off the development charges which had been necessary in the business, and which were always necessary in any business that had assumed such large proportions as that of the company. They had adopted that policy deliberately, because they believed that it added to the safety and strength of the undertaking to get those charges repaid as quickly as possible. According to the *Times* report the chairman said that both the directors and the principal shareholders were agreed that the main object of the company should not be so much the distribution of profits as the placing of the concern at the earliest possible moment in a strong position by clearing off the development charges essential to the establishment of a large manufacturing business. That period of development had, happily, nearly passed.

Mr. G. Franklin seconded the motion, which was adopted.

Dolter Electric Traction, Ltd.

Mr. H. N. Lubbock presided at the third ordinary general meeting of the company held at the offices, 3 and 4, Great Winchester Street, E.C., on Tuesday. He moved the adoption of the report to September 30th, 1804, in which it was stated that since their last report the sanction of Parliament had been obtained to the company's application for powers to lay the Dolter system in Torquay. The directors had stated that the French Dolter Co. had lately laid an experimental line in Dresden, and the line was showing most excellent results.

The Chairman said that at the previous meetings they had been unable to report headway in the introduction of their system of electric traction, but they had now turned the corner, and they had powers to lay their system at Torquay, which was an ideal town in which to demonstrate the system. The balance-sheet contained an item of £1,647 for travelling, advertising, and exhibition expenses, salaries, &c. This might seem excessive, but it included £305 in respect of fees of their consulting engineers, and the cost of an exhibition at Poplar. The item of £550 for directors' fees had not been paid but only credited, and would not be paid until the company earned profits. The expenses *re* Torquay Bill were £3,586. During the passage of the Bill unexpected opposition arose both from the carriage section of the inhabitants and from the Torquay Gas Co. The latter tried to obtain the benefit of an electrolysis clause, but did not succeed. They had hoped to secure the Bill for £2,000, but it was necessary to secure an exhibition of the system in this country at any cost. The directors were now engaged in negotiating the necessary financial arrangements.

A question was asked as to whether the company intended working the Bill themselves, and raising the necessary capital. The chairman replied that when they put their scheme before the shareholders they would be better able to answer that question.

Mr. T. O. Callender seconded the adoption of the report, and it was agreed to.

Arc Lamps, Ltd.

The fourth ordinary general meeting of the shareholders of the above company was held on Wednesday at the offices, 62, Old Broad Street, Mr. C. Williamson Milne presiding. A representative of the Electrical Review was informed that the proceedings were private. The third annual report which was before the meeting was for the year ended July 31st, 1904. The gross profit for the period under review was £5,112, as compared with £5,835 for the year to July 31st, 1903. After payment of all expenses of management, and after substantially depreciating machinery and plant, the surplus was £1,243, a considerable reduction on the net profit of last year, which amounted to £2,629. The report says:—

> Notwithstanding the depression which existed in a marked degree in the electrical trade during the period covered by the accounts, the turnover only suffered to the extent of 5 per cent., but the prices obtained have been very considerably reduced. This reduction in price was rendered necessary chiefly in order to meet the keen competition created by the British market being flooded with cheap American and Continental lamps. By reason of the new patent referred to in the last report and other improvements of more recent date, the directors hope to considerably increase the profits in the current year. The construction of the lamp has been simplified and the cost of manufacture reduced. Numerous and important additions have been made to the list of customers, and one of the satisfactory features has been the manner in which former customers, who know and appreciate the lamp, have continued their support, notwithstanding the inducements of cheaper lamps offered by other makers. In January the board appointed, as indicated above, an experienced representative to visit all the large towns in England and Ireland, for the purpose of making the lamp more widely known. Valuable new ground has been opened up as a result of his thorough canvass of provincial electrical engineers and contractors. The directors have allocated districts to agents, with headquarters at Newcastle, Bristol, Cardiff, and Hull.
>
> The directors regret that the action raised in March, 1903, against this company by the Jandus Arc Lamp and Electric Light Co., Ltd., has not yet been finally disposed of. In November this company successfully applied for the restoration of the case to the List, and every effort will be made to get the action fought with the least delay. The directors have not charged the cost of this action against revenue; a proportion thereof is payable by the plaintiffs, under the terms imposed by the Court in November, 1903. The directors declared an interim dividend at the rate of 5 per cent. per annum for the first half of the year ended July 31st, 1904, and although there is a balance of £1,168 at the credit of revenue and expenditure account, the directors do not recommend a further dividend.

Provincial Tramways Co.—The report for the year ended September 30th states that the net revenue received from the local companies has been £24,095, against £23,353 last year. There has been set aside for depreciation £7,000, and the directors recommend a dividend on the ordinary shares of 3s. per share, making 6s. per share for the year ended September 30th, 1904.

British Electric Traction Co.—The directors have declared the usual interim dividend on the ordinary shares at the rate of 6 per cent. per annum for the half-year to September 30th last.

Stock Exchange Notice.—The Committee has ordered the under-mentioned securities to be quoted in the Official List:—Hadfield's Steel Foundry, Ltd.—Further issue of 50,000 ordinary shares of £1 each, fully paid, Nos. 250,001 to 300,000.

South Wales Electrical Power Distribution Co.—An extraordinary meeting of the company was recently held at the offices, Queen Street, Cardiff, when the chair was occupied by Mr. Robert Forrest. A resolution was passed authorising the directors to create £50,000 additional debenture stock, bearing interest at the rate of 5 per cent. per annum (being the third instalment of £50,000, part of the £250,000 which the company is empowered to borrow under Section 26 of the said Act) and to issue the same as the directors think fit.

STOCKS AND SHARES.

Wednesday Evening.

Markets in the Stock Exchange are now becoming infected with the Christmas spirit, and business has fallen off considerably. The volatile American Railroad section has grown tired of its frenzied finance; in Kaffirs there is very little doing; Home Rails continue neglected; Industrials are passed by on one side. For all this, the Electrical sections have several points of interest, and the Telegraph market has lost little of its lately-developed strength. Manufacturing shares are better, and the slump in India-Rubbers has passed now that the worst is known. The price is 10s. better after its heavy drop. Electricity Supply shares have not varied to any great extent, but some of the best are improving upon the approach of the dividends.

National Telephone Deferred continues to forge ahead, and marks another rise of 1½ to 101½. Allusion to the coming dividend was made last week, and the market prophets seem to think a larger distribution is in prospect than that declared early this year. The talk of Government purchase has given place to other suggestions that the company may be permitted to remain a separate undertaking, after all. The 6 per cent. Preferred stock is still 109, but the first Preference shares are slightly better, and the third Preference at 5⅜ have risen $\frac{1}{16}$, although the 32 per cent. Debenture stock lost its 10s. advance, and is back to 98½. Other telephone descriptions have not changed.

In the telegraph list, the improvement has grown more general. The Anglo-American and Eastern groups are, perhaps, mostly favoured. A fall of ½ in Anglo "A" to 12¼ is a market movement reflecting the gamble still going on in this counter. The Preferred hardened ½ to 103½. Direct United States shares failed to score, but the Direct Spanish Preference are ¼, and the Ordinary ⅛, up at 8 and 3½ respectively. Eastern Telegraph Ordinary rose 2 on the dividend; Chinas have not changed. Amongst the falls, a a drop of ¼ in Great Northerns to 29 is the only noticeable alteration. A fresh rise of ⅛ in Globe Telegraph Ordinary and Preference follows upon the firmness of Telegraph stocks as a whole, and there has been an inquiry for Reuter's, which raised the price ¼ to 7¼, inflexible as it usually is. Of the dividend deductions from West India and Panama First Preference, and Western Telegraph shares, the amount upon the latter has been recovered, and as regards the former, the nominal fall of ⅜ to 7½ is represented by the 7s. distributed. The price of Telegraph Constructions is widened, in the upward direction, to 38—40. The steep drop of India-Rubber, Gutta-Percha shares brought in a few cheap buyers after the meeting, with the result that the price rallied to 16 middle. On the other hand, Henley's weakened 5s. to 10½. Callender's keep steady at 9⅜ middle.

Publication of the new agreement between the Metropolitan and the Great Central Railways, whereby the latter covenants to pay certain substantial rentals to the former, has not sufficed to help the price of Metropolitan Consolidated, which is down ½ to 97½, Districts being a like fraction lower at 40, the company's over-capitalisation having received a good deal of critical attention of late. But this may be conveniently forgotten when electrification provides an appropriate moment to put the price better. City and South London lost ½ at 46; last week's traffic showed a decline of £110. Central London Ordinary is a point easier at 91, but Great Northern and City Preferred hardened to 6¼, the miserable weather of this month being an excellent advertisement of the superiority the "Tube" possesses over the easily-disorganised traffic on the Great Northern and North London services. A scheme is said to be projected for the incorporation of a big company with an authorised capital of five millions sterling in order to supply London and its suburbs with electric power.

This idea has not prevented a hardening of values in the Electricity Supply division. Metropolitan Electrics are ¼ better at 17, Charing Cross new Preferences $\frac{1}{16}$ at 5, Westminsters ¼ at 13, and City Ordinary ¼ at 11. But St. James's lost ¼ at 14, nor did the rise in Westminster Ordinary save a fall of ¼ in the Preference, which are 6½. The two movements look as though somebody was changing Preference shares for Ordinary. The Debenture stocks are steady, almost without variation of any kind. Brush Preference came into renewed demand, showing ⅛ improvement at 1⅛, and with this it seems appropriate to couple a mention of ⅛ rise in British Electric Traction Preference.

After the slight flutter produced by the Buenos Ayres strike, the Argentine Tramway shares have settled down to steady strength again. Anglo-Argentine Ordinary are $\frac{1}{16}$ better at 7⅛, the Preference 5½, and City of Buenos Ayres 10⅜. The Buenos Ayres and Belgrano quintet remains unchanged. London United Tramways Debenture was done at 105 on Tuesday, which is rather better, and Calcutta Debenture was bought at 109. Cape Electrics at 30⅝, Dublin United at 13½, and Metropolitan Street Deferred at 7s. 6d., are also unaltered.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Dec. 14th.	Closing Quotations Dec. 21st.	Business done week ended Dec. 21st, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	100 —103	100 —108	..	..
95,000	Amazon Telegraph Co.'s shares, Nos. 1 to 95,000	10	..	..	..	1 — 1⅛	1 — 1⅛	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. —		
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	55 — 57	55 — 57	56¼	56
3,105,580	Do. do. do. 5 % Pref.	Stock	6 %	6 %	6 %	104 — 104	103 — 104	104¼	102½
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	12½ — 12⅝	12½ — 12⅝	12⅝	12 1/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5¾ — 6	5¾ — 6	..	..
18,888,800§	Commercial Cable	£100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 96	93 — 96	95⅝	94½
16,000	Cuba Telegraph	10	4 %	6½%	5 %	8⅝ — 9¼	8⅝ — 9¼	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16½ — 17½	16½ — 17½	..	..
17,931	Direct Spanish Telegraph, Ord.	5	..	..	..	3½ — 3¾	3⅝ — 3¾	3¾	3 7/16
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7½ — 8	7¾ — 8¼	..	..
60,000	Do. do. 4½ % Debs.	50	..	..	..	101 —103	102 —104	..	..
60,710‡	Direct United States Cable	20	3½%	3½%	3 %	10⅜ — 11	10⅜ — 11	..	..
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	100 —102	101 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	133 —136	135 —138	137	134½
1,955,555	Do. 5% Pref. Stock	100	..	..	..	88 — 90	88 — 90	89	88
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	105½	105
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	13⅜ — 14	13½ — 14	13⅞	13⅝
320,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	106 —108	106 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	101 —103	101 —103	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	100 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	10⅜ — 10⅝	10½ — 10⅝	10 7/16	10 5/16
180,042	Do. do. 6 % Pref.	10	..	..	..	13⅜ — 14½	14 — 14½	14⅜	13⅞
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	29 — 29½	28½ — 29½	..	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	..	..	..	101 —103	101 —103	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	44½ — 46½	44½ — 46½	..	..
72,680	Monte Video Telephone Co, Ltd., Ord.	1	2½%	3 %	3 %	⅞ — 1	⅞ — 1		
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	108½ —10 ½	108½ —109½	109½	108
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	99½ —100½	101 — 104	102⅝	100½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 15	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼ — 5⅜	5⅛ — 5 7/8	5⅜	5½
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	98½ — 99½	98 — 99	98½	98½
689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101½ —10 ½	101½ —105½	105	101½
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	67½ — 68½	67½ — 68½	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	1 — 1⅛	1 — 1⅛	1 1/16	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛ — 1¼	1⅛ — 1¼	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	98 —100	98 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6⅞ — 7⅛	7 — 7⅛	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	119 —122	120 —123	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5⅝ — 5¾	5⅝ — 5¾	..	..
172,947‡	Do. do. 5 % Debs.	Stock	..	..	..	105⅛ —107⅛	105⅛ —107⅛	107¼	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	⅜ — ⅝	⅜ — ⅝	..	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	98 — 100	98 — 100	99⅜	97½
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	13½ — 14	13½ — 14 xd	13⅞	13½
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	103 —105	103 —105	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101½ —103½	101¼ —102½	..	..
88,891	West India and Panama Telegraph	10	..	..	..	⅜ — ½	⅜ — ½	..	..
84,553	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7⅛ — 8	7⅛ — 7½	7⅜	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	6⅜ — 7½	6⅜ — 7½	..	..
80,000	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	103½ —105½	103½ —105½	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	7⅛ — 8	7⅞ — 8¼	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	8¾ — 9¼	8⅞ 9	..	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	96 — 100	96 100	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅜ — 10½	9⅜ — 10½	10	9⅜
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10⅜ — 11	10 13/16 — 11 1/16	10⅝	..
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	117 —119	117 —119	118¼	..
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	95 — 97	..	..
100,000	British Insulated and Helsby Cables	6	10 %	10 %	8 %	5¾ — 6⅛	5¾ — 5⅞	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	6¼ — 6⅜	6¼ — 6⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —105	102 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	7/16 — ½	7/16 — ½	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	⅝	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	1½	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	68 — 72	69 — 73	69½	69½
85,000	Callender's Cable Construction shares	6	20 %	15 %	12½%	9½ — 10	9½ — 10	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	⅝ — ⅝	6 — 6¼ xd	6½	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —106	104 —106	105	..
1,980,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	91 — 93	10 — 92	92	91½
494,096	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	100	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	84 — 86	84 — 86	..	..
1,800,000	City and South London Railway	Stock	2 %	3½%	2¾%	46 — 47	45½ — 46½	46½	45½
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	5 %	..	1⅝ — 2	1⅝ — 2	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	93 — 98	94 — 99	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	⅝ — ⅞	⅝ — ⅞	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..
344,028‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	78 — 83	78 — 83	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1⅛ — 1¼	1⅛ — 1¼	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2⅛ — 2⅜	2⅛ — 2⅜	2 1/16	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 — 100	98 —100	98½	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½ — 10	9½ — 10	10	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	93	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10½ — 11	10½ — 10⅝	10⅝	10½
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	110 —112	110 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	15 — 16	15½ — 16½	16	15½
900,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3⅛ — 3⅜	3⅛ — 3⅜	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,850	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	38 — 39	38 — 40	39	..
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	103 —105	103 —105	..	..
140,000‡	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	88 — 90	88 — 90	..	..

* A period of nine months. ‡ Quotations on Liverpool Stock Exchange. † Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

(Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued). — ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Dec. 14th.	Closing Quotations Dec. 21st.	Business done week ended Dec. 21st, 1904. Highest.	Lowest.
		†							
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8%	8 %	10 %	10¾ — 11	10½ — 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10½ — 10⅝	10½ — 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	104 —107	104 —107	..	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	10 %	8 %	8⅛ — 8⅜	8⅛ — 8⅜	8 1/16	8¼
70,000	Do. do. do. 4½% Cum. Pref. ..	£	..	..	..	5 5/16 — 5 7/16	5 5/16 — 5 7/16	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	4 7/16 — 5	4 7/16 — 5 5/16	5	..
40,000	Do. do. 1903	£	..	..	..	4 7/16 — 5	4 7/16 — 5 5/16	5 5/16	4 7/16
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	103 —105	101 —103 xd	102½	..
44,486	*Chelsea Electricity Supply, Ord.	£	4 %	4½%	5½%	6⅜ — 6⅝	6⅜ — 6⅝	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —111	109 —111	110½	110
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	5 %	10¾ — 11	10⅞ — 11⅛	11	10⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	..	..	..	13⅛ — 14	13⅜ — 14	13 5/16	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	£	..	..	..	128 —127	128 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	100	..	..	..	103 —105	103 —105	104½	..
40,000	County of London Electric Lighting, Ord. 1—40,000 ..	£	4 %	4 %	4 %	9 — 9¼	9 — 9¼	9¼	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	£	..	..	..	12 — 12½	12 — 12½	..	..
400,000£	Do. do. 4½% Deb. Stock	£	..	..	..	107 —110	107 —110	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —103	101 —103	..	..
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	7 %	6½ — 6⅝	6½ — 6⅝	6 3/16	..
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	6 — 6¼	6 — 6¼	6¼	..
800,000£	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	106 —108	107 —109	108	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	10 %	12%	12¼ — 13	12½ — 13	12 7/8	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	..	2 3/16 — 2 5/16	2 3/16 — 2 5/16	..	..
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5 3/16 — 5 5/16	5 3/16 — 5 5/16	5 5/16	5 3/16
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red ..	Stock	..	..	..	97 — 99	95 — 97 xd	96 7/8	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	6½%	7½%	8½%	16¼ — 17	16⅜ — 17½	17 3/16	16⅞
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5 7/16 — 5 9/16	5 7/16 — 5 9/16	5 5/16	..
230,000£	Do. do. 4½% 1st Mort. Deb. Stock	£	..	..	..	112 —117	112 —117	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 — 99	97 — 99	..	..
10,852	Notting Hill Electric Lighting	£	6 %	6 %	6 %	14½ — 15	14½ — 15	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	101 —103	101 —103	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	14 — 14½	13⅞ — 14¼	13 15/16	14
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	..	..	..	8¾ — 9	8¾ — 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	91 —101	99 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	..	2½%	4 %	2⅞ — 3⅛	2⅞ — 3⅛	3¼	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 87	83 — 87	..	..
66,000	South London Electricity Supply, Ord.	£	..	1½%	3 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..
100,000	South Metropolitan Electric Light and Power (Ord.	£	..	..	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..
50,000	(Late Blackheath and Greenwich 7 % Pref.	£	..	..	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..
100,000	Dist. E.L.Co.) 4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	108½	..
80,000	Urban Electric Supply, Ord.	£	..	..	..	4 13/16 — 5 1/16	4 13/16 — 5 1/16	5 3/32	..
80,000	Do. do. 5 % Cum. Pref	£	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	5 3/32
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	100	..	..	..	104 —106	104 — 106	..	..
410,000	Westminster Electric Supply, Ord.	£	10½%	12 %	13½%	12⅞ — 13	12⅞ — 13¼	13¼	12⅞
28,141	Do. do. 6 % Cum. Pref.	£				⅞ — 7	⅞ — 6⅞	6⅞	6½

*Subject to Founders Shares. † Unless otherwise stated all shares are quite paid.

MARKET QUOTATIONS, Wednesday, December 21st

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 5	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90%)	per gal.	7/-	..
a ,, (50/90%)	per gal.	5/6	..
a Copper Sulphate	per ton	£23	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	8d.	..
a ,, Caustic (75/80%)	per ton	£19	..
a Shellac	per cwt.	240/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70%) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2¼d.	..

METALS, &c.

b Aluminium Ingots, in ton lots ..	per ton	£180	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£48 to £140	..
c Brass (rolled metal 2' to 12") basis	per lb.	7¼d.	..
c ,, Tube (brazed) ..	per lb.	9¼d.	..
c ,, ,, (solid drawn)	per lb.	8¾d.	..
c ,, Wire, basis	per lb.	7¾d.	..
c Copper Tubes (brazed)	per lb.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	10¼d.	..
c Copper Bars (best selected ..	per ton	£79	..

METALS, &c. (continued).

		Latest Price.	Week's Dec. or Inc.
g Copper Sheet	per ton	£79	..
g ,, Rod	per ton	£79	..
g ,, (Electrolytic) Bars ..	per ton	£70 10	..
g ,, Sheets ..	per ton	£87	..
g ,, Rod ..	per ton	£81	..
g ,, ,, H.C. Wire	per lb.	9¼d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	5/2 to 5/3	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	48/5	11d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£13	2/6 dec.
g ,, ,, Sheet	per ton	£14 5	5/- dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 15	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/0¾ to 1/3	..
p ,, rolled bars & rods	per lb.	1/0½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/2	..
o Platinum	per oz.	81/6	..
e Silicium Bronze Wire	per lb.	10d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£131 10 to £132 10	20/- to 30/- dec.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/8	..
p White Anti-friction Metals—			
"White Ant" brand ..	per ton	£48 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne brd.)	per ton	£29 7 6	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Tramways.	Aberdeen	Dec. 17	1,063	— 13	29	41,687	+ 5,714	10	—
	Bath	,, 14	495	—	51	31,692	—	12½	—
	Birmingham	,, 17	5,488	+473	51	274,008	+15,609	8½	—
	Blackburn	,, 9	738	+ 1	36	34,879	+ 3,884	13½	—
	Blackpool	,, 15	261	+ 6	37	42,898	+ 5,940	8½	—
	,, —Fleetw'd	,, 17	153	—	24	20,916	+ 388	7½	—
	,, —Lytham	,, 8	124	— 7	6	730	—	7½	+ ½
	Bolton	,, 18	1,678	+ 68	38	69,978	+ 556	25	—
	Bournemouth ..	,, 14	798	— 12	37	41,322	—	10½	—
	Bradford	,, 10	3,585	+284	34	165,738	+26,717	64	—
	Brighton	,, 11	719	— 2	36	37,987	—	9	—
	Bristol	,, 16	4,586	+ 81	—	—	—	28	—
	Devonport	,, 2	415	— 3	48	25,517	+ 3,255	5	—
	Dudley—Sto'rb'ge	,, 2	707	- 26	48	41,685	+ 1,342	18½	—
	Gateshead ..	,, 2	887	+ 2	48	43,705	+ 1,358	10½	+ ½
	Gr'n'k—Pt. Glsgw	,, 2	465	+ 27	48	27,714	+ 1,398	7½	—
	Oldham—Ashton	,, 2	445	— 49	48	26,306	— 1,108	5	—
	Potteries	,, 2	1,629	— 19	48	82,602	+ 5,924	28½	—
	South Staffs. ..	,, 2	619	—331	48	36,756	— 7,665	21½	—
	Swansea	,, 2	444	— 32	48	26,000	+ 934	5½	—
	Wolverhampton ..	,, 2	821	— 6	48	18,720	— 88	10½	+8
	Yorks. Wool Dist.	,, 2	463	+ 28	48	27,989	+ 8,828	6	—
	Miscellaneous ..	,, 2	2,560	—	48	171,887	—	—	—
Elec. Tramways.	Burnley	,, 17	987	+ 218	—	—	—	10½	+ 2½
	Burton-on-Trent ..	,, 18	288	- 6	37½	13,010	—	8½	—
	Cardiff	,, 8	1,816	+116	35	72,813	+ 1,653	14	—
	Chatham & District	,, 15	802	— 17	50	29,060	+ 2,090	9 3/8	—
	Cork	,, 16	876	— 18	50	25,819	— 2,480	7 7/8	—
	Dover	,, 17	190	+ 11	50	10,791	— 578	4	—
Elec. Railways.	Dublin	Dec. 16	4,404	+ 57	—	122,222	— 2,387	47	—
	East Ham	,, 17	618	+ 24	37	27,048	+ 1,509	6½	—
	Glasgow	,, 17	13,360	+181	29	412,821	+20,295	72½	+ 3
	Halifax (2 weeks) ..	,, 14	2,261	+109	37	55,346	+ 4,070	34½	+ 3
	Huddersfield ..	,, 17	1,170	+ 62	37	50,417	+ 3,090	28	—
	Hull	,, 17	2,115	+175	37	81,720	+10,484	13	+2
	Ilkeston	,, 14	93	— 91	37	5,206	+ 928	3·5	—
	Ipswich	,, 17	868	+ 151	37	18,332	—	10½	+4
	Isle of Thanet ..	,, 17	284	— 6	50	31,327	+ 1,610	10½	—
	Leeds	,, 17	5,411	+ 454	98	220,508	+12,845	89½	+7½
	Liverpool	,, 10	9,707	+181	50	516,577	+14,277	103	—
	London C. C. ..	,, 3	11,876	+3604	35	452,688	+97,864	47½	+7½
	Manchester	,, 17	11,677	+637	37	456,462	+19,391	137½	+13½
	Newcastle	,, 17	3,544	+ 23	—	—	—	17	—
	Portsmouth	,, 17	1,487	- 63	38	71,443	+ 5,792	14½	—
	Salford	,, 12	3,749	+ 8	36	149,658	+ 7,877	30	—
	Sheffield	,, 18	4,548	+310	39	177,971	+ 3,898	34½	+1½
	Southampton	,, 8	805	— 55	36	36,015	— 2,327	16½	—
	Southend-on-Sea ..	,, 14	205	+ 9	37	13,965	+ 1,399	6½	—
	Sunderland	,, 18	1,116	+ 44	37	47,804	+ 1,092	21	+1
	Tyneside	,, 14	306	+ 48	50	19,319	+ 3,244	8·9	+ ·4
	West Ham	,, 15	1,014	—	42	39,765	—	9·78	—
	Wolverhampton ..	,, 14	663	+277	—	—	—	9·5	—
	Cen. London Rly. ..	,, 17	7,182	— 72	24	153,365	— 255	6	—
	City & S. Lon. Rly.	,, 18	2,960	—110	25	2,416	— 2,416	6½	—
	Dublin—Lucan Rly.	,, 16	91	+ 9	24	3,016	— 7	6½	—
	G. N. and City Ry.	,, 17	1,405	—	44	45,907	—	3½	—
	L'pool Overh'd Rly.	,, 18	1,482	—167	25	39 109	— 2,249	8	+ 4½
	Tower Railway ..	,, 17	648	232	24	20 744	8 4	3	—

* Compared with the corresponding period of 1903.

THE COMBINATION OF DUST DESTRUCTORS AND ELECTRICITY WORKS ECONOMICALLY CONSIDERED.

By FRANK BROADBENT.

The above is the title of a paper read on the 15th inst. before the Inst. E.E. by Mr. W. P. Adams. To say that the author has been at considerable pains to collect his data, is but to echo and confirm an expression which occurs frequently in the paper itself.

Prof. Forbes, in 1892, stated that if the refuse then collected in Paddington were properly burnt and used in the most economical way, it should provide enough electricity to light one 8-c.p. lamp every night of the year per head of the population. "It is a great pleasure to me," says Mr. Adams, "to take upon myself the vindication of Prof. Forbes as a prophet, for by the exercise of a small amount of scientific licence, I am able to demonstrate that in at least two metropolitan boroughs the result will certainly be achieved within a few years." The learned Professor will, no doubt, be duly grateful to his champion, but it is doubtful if destructor makers and station engineers will be quite so thankful. Even so enthusiastic and experienced an expert on destructors as Mr. W. F. Goodrich says, in his excellent work on "Refuse Disposal and Power Production," that Prof. Forbes and the "Golden Dustman" were both taken too seriously. And what was the result? The claims put forward were far from being realised in practice, and to quote from the volume referred to above: "The harm done by enthusiastic professional men at this time has had its effect ever since. Results in power production were prophesied which have not yet been attained, and never will be attained. This is a candid admission, but no apology is needed. The modern destructor has an excellent record, but it has its limits, and had this been recognised at its advent, much misunderstanding might have been avoided, and as the result greater progress might have been recorded." And, surely, what Mr. Goodrich does not know about the capabilities of the modern refuse destructor is scarcely worth knowing. Now comes Mr. Adams, doubtless with the best intentions, boldly claiming more than the most sanguine estimate ever previously advanced by the most ardent partisan.

It is to be hoped that his good intentions will pave the way to a better end than the destination usually attributed to such motives.

One or two of the author's suggestions will be most strongly objected to by all true sanitarians, viz., (1) the proposal to store the refuse and burn it as the demand requires; and (2) the suggestion that municipalities should let out to contract, say to a rag and bone merchant, the picking over of the refuse prior to its cremation. The danger to health resulting from both practices is one of the strongest arguments in favour of cremation.

The bulk of the paper is interesting enough, although a considerable portion of it is common knowledge; but the point—which is really the essence of the paper—to which exception must be, and has been, taken is the exaggerated claims which are made as to the steam-raising efficiency of various destructors. These claims are the result of what the author calls "the exercise of a little scientific licence."

At Fulham the average value of the refuse in units per ton of refuse destroyed is given by the borough electrical engineer, Mr. Fuller, as 25·5 for the year ending March, 1903. That the average is less than the maximum no one would think of disputing; that it may be half the maximum is quite probable. Mr. Adams essays to demonstrate, by means of curves, that, at times, the duty is as high as 94 units per ton, "and can see no reason why the fine values obtained on the peak load should not be maintained throughout the day; and if it were at all possible to avoid shutting down on Sundays for cleaning purposes, throughout the week"; and if throughout the week, he might have added, Why not throughout the year?

Then, turning to Hackney, where the average value throughout the year is 41·1 units per ton of refuse destroyed, the author sees "no reason why 100 units a ton should not be reached throughout the day," and "if 90 units per ton is obtained at Fulham, 120 or even more ought not to be an impossible figure at Hackney."

Load curves are then given, from which the author calculates that outputs ranging from 98·3 to 105·8 units per ton are obtained on the peak loads.

Now, are these really true values, or has Mr. Adams allowed himself too much "scientific licence"?

Considering Fulham first, the author says: "I have taken great pains to ascertain the actual coal consumed per unit at Fulham." This is given as 8 lbs., running condensing, and is the average figure, corresponding with an average consumption of 59 lbs. of water per unit. Now, the method adopted by the author to arrive at the maximum refuse value is to take a day's load diagram and find out how much coal was used during the peak. On January 9th, 1904 (see diagram, fig. 1), the quantity used was 15,230 lbs. between the hours of 4.30 and 11.30 p.m. Dividing this by 8 (the average figure for coal per unit), the author credits the coal with 1,904 units, crediting all the rest to refuse, and working out the value to 94 units per ton. It is obvious that as the

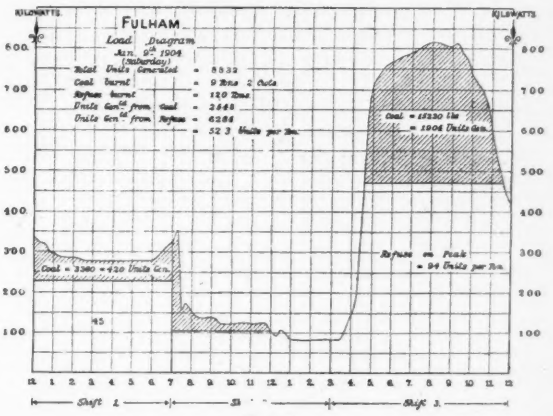


Fig. 1.

author reckons 8 lbs. of coal per unit, the water consumption per unit must, to be consistent, be taken at 59 lbs. On this basis we find that the refuse must evaporate, in order to produce 94 units a ton, *over 2·4 lbs. per lb. actual.* Now, as the author rightly points out in a previous part of his paper, "the steam raising test, when the plant was newly installed, gave 1·15 lbs. of steam per lb. of refuse." Why, therefore, should the destructor, during the "peak," give an evaporation of over double this, and, according to the author, be expected to do this duty as a regular output from week's end to week's end? But during the evaporation test referred to the electrical output was equal to 60 units per ton of refuse, and at 1·15 lbs. of water per lb. of refuse, this works out to 43 lbs. of water per unit. As this was in the pre-condenser days, the figure should now be reduced to 38 lbs., to correspond with Mr. Adams's reduction in coal consumption, from 9 lbs. to 8 lbs. This is a very different figure from the average of 59 lbs.

The author assumes then, that the refuse, during the peaks of the load curve, evaporates double what it did on the official test, and that the evaporation from coal never rises above the average value.

When working on top load, the evaporation is, on the author's assumption, the same as when the boiler fires are banked! The proposition is absurd on the face of it. The consumption on the peak would be more like the average for the day during the destructor test, and this would work out to about 5·2 lbs. of coal per unit, or to allow a little margin, say, 5½ lbs. On this basis the coal-generated units in the diagram, fig. 1, should therefore be reckoned at about 2,760, leaving about 2,500 for the refuse, which, assuming the average rate of destruction of 5 tons per hour to hold good right through the peak, works out to 71·5 units per ton. It is, however, most unlikely that the destructor furnaces are not worked a little above the average rate during the peaks of the load. The probabilities are that during these periods the average rate of 5 tons an hour is greatly exceeded. Any increase on the average rate lowers the calculated value of units per ton below 71·5. Then, it must not be overlooked that 17·8 per cent. of the steam generated is used for the forced

draught, and when this is deducted the available energy is a little under 60 units per ton. This, if not "a very fine value," to use the author's expression, is a very satisfactory performance, and is, at least, believable. Furthermore, the units generated, minus those used for the blast, are not all useful units, as all the auxiliaries are electrically driven.

Mr. Adams then turns his attention to Hackney, and, following the same line of reasoning, shows that on three successive days—viz., December 16th, 17th and 18th, 1902—the gross outputs per ton of refuse consumed were respectively 98·3, 105·8 and 99·2 units. Fig. 2 shows the load curve for December 17th, the record day. The shaded portion represents the units generated from coal according to Mr. Adams's calculation. It will be seen that here a coal consumption of 5 lbs. per unit generated is taken.

This is the average figure for the year when running condensing, the water consumption averaging 30 lbs., or an average evaporation of 6 lbs. per lb. The record figures for refuse given above are, if really correct, very remarkable, and it will be of interest to compare them with an evaporation test made on December 4th and 5th, 1902, about two weeks before the above alleged records were achieved.

The test referred to lasted 19 hours, and the weather was fine. The actual evaporation at 184 lbs. per sq. in. pressure was 1·159 lbs. per lb. of refuse, and 1·415 lbs. from and at 212° F. The refuse burnt per cell per hour was 1,393 lbs. The units actually generated, running non-condensing, were 54·19 per ton of refuse.

This works out to about 48 lbs. of water per unit non-condensing, which is a much higher figure than the present average of 30 lbs. condensing.

The average evaporation throughout the year is 0·54 lb. per lb. of refuse.

To return now to Mr. Adams's figure of 105·8 units per ton. This, at 30 lbs. of water per unit, equals a total of 3,174 lbs., or an actual evaporation of 1·47 lbs. of water per lb. of refuse, an increase of 27 per cent. on the evaporation test of a fortnight before. The rate of burning during the evaporation test was, as given above, 1,393 lbs., and the rate throughout the day to which the load curve, fig. 2, refers, is given as 0·6 ton, or, say, 1,344 lbs., and the author says, "the refuse was burnt uniformly throughout." As nearly as possible, therefore, the destructor was worked under precisely similar conditions

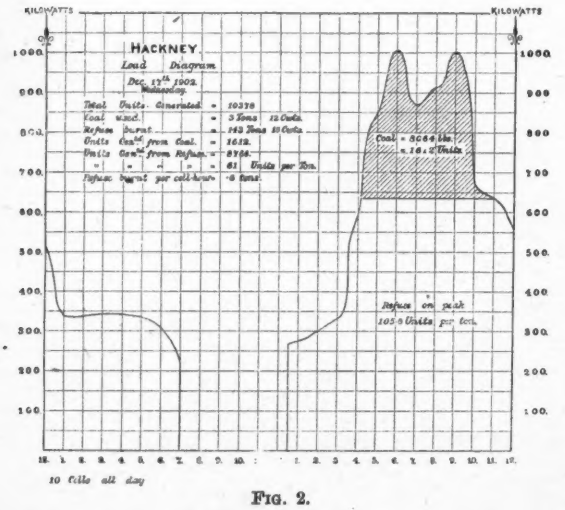

KILOWATTS
KILOWATTS
HACKNEY
Load Diagram.
Dec. 17th 1902.
Wednesday.
Total Units Generated = 10378
Coal used = 3 Tons 12 Cwts.
Refuse burnt = 143 Tons 10 Cwts.
Units Gen.d from Coal. = 1618.
Units Gen.d from Refuse. = 8760.
" " " " = 61 Units per Ton.
Refuse burnt per cell-hour = ·6 tons.
Coal = 5664 lbs.
= 1618 Units
Refuse on peak
105·8 Units per ton.
10 Cells all day

Fig. 2.

on the two occasions, yet on one day the evaporation is an actual 1·159 lbs. per lb. and on the other 1·47. As in the case of Fulham, the author credits the coal consumed with only the same evaporation on the peak loads as on banked fires—that is, he just takes the average rate right through, but the refuse does about 40 per cent. better on the peak than the average, notwithstanding the fact that it is "burnt uniformly throughout, without any attempt to force the cells during the hours of heavy load." It is often said that anything can be proved by figures, and the common-sense test is often more reliable, and is usually the final court of appeal. Now what is the common-sense way of looking at the above curves? Surely, that with a steady rate of burning, and uniform conditions, the rate of evaporation would be approximately steady also. Assuming, then, the average test value of 1·159 lbs. for each pound of refuse, the units generated per ton, at 30 lbs. of water per unit, would be 86·5 units—a very high value indeed. This, on the peak load, represents about 3,100 units generated from refuse, and

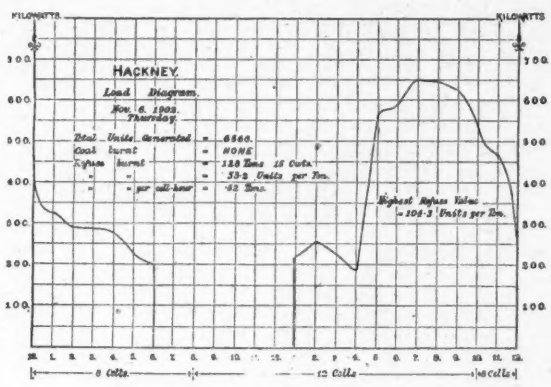


Fig. 3.

about 2,290 from coal, the latter, on this basis, working out to about 3½ lbs. per unit. From 3½ to 4 lbs. is not an unreasonably low consumption on a peak load in a station whose average is 5 lbs.

Turning now to fig. 3. Here is a load diagram for November 6th, 1902, a month earlier than the evaporation test already referred to. On this diagram no coal is shown, nor is there anything to indicate that the battery has helped the destructor over the peak, and Mr. Adams calculates "highest refuse value = 104·3 units per ton." There is no getting away from the fact that this is an abnormally fine result. But is it really quite so fine as it looks on paper? This record is based on a two hours' flying run only at the tip-top of the peak, and it is necessary to assume that during these two hours the average rate of burning for the day is not exceeded, viz., 0·52 ton per cell per hour, although, according to published records, a rate of over 0·75 ton per cell has been maintained throughout a whole day. It is obvious that a small increase in the rate of combustion for two hours will materially affect the result. Even so low a rate as 0·6, the *average* rate for three consecutive days, brings the figure down from 104·3 to about 90 units, whilst the more probable rate of at least 0·75 for this short time reduces the figure to about 72 units per ton. The whole thing, therefore, depends upon the trimmer dropping down a couple of hundredweight or so more refuse into the furnace than the hourly average. This, then, is the very slender basis upon which the record depends.

But anyone who has a practical acquaintance with destructors knows that when everything is at its maximum temperature there is a very considerable store of heat in the brickwork, some of which is given up during heavy loads. At Wrexham, feed and deep well pumping are carried on during the night after the fires are banked, to prevent steam blowing off. What a "fine" record the author could show here on the night diagram! Then there is the heat stored in the boilers themselves, and the economisers, which store is also drawn upon during the peak. A two hours' flying record is of no value at all, and is one that no destructor maker in the country would base any data upon, and upon which none with a reputation to lose, would try to get an order. It would be necessary to show that the state of the fires was the same at the end as at the beginning of the run, that the steam pressure was exactly the same, and that the height of water in all the gauge glasses was the same, and, in fact, that everything was the same; none of which data are given in the paper. Then, again, in making any comparison between one combined station and another, it is very necessary to put them on the same basis.

Both at Fulham and Hackney the feed, air and circulating pumps are electrically driven, so the units generated per ton are quite naturally higher than in a station where the

auxiliaries are steam-driven. What is wanted is the useful output. It is also necessary to remember that from the figures given in diagrams must be deducted the energy required for the forced draught, &c., viz., for Fulham, 17·8 per cent.; Shoreditch, 12·3 per cent.; and Hackney, 9 per cent.

The writer fully recognises the immense strides that have been made of recent years in the efficiency of destructors, both from the sanitary and steam-raising aspects, but more harm than good is likely to result from the publication of records, which, however interesting from an academic standpoint, may be taken too seriously by the public.

INSTITUTION OF ELECTRICAL ENGINEERS.

STUDIES IN MAGNETIC TESTING.

A paper on this subject was read by Mr. G. F. C. Searle, M.A., of the Cavendish Laboratory, Cambridge, before the London meeting, on the 8th inst. The work, says the author, may be looked on as a rough attempt at a critical examination of the use of the ballistic method in magnetic tests of transformer iron. Previous magnetisation has a very marked effect upon the behaviour of transformer iron in subsequent tests, which can only be satisfactorily wiped out by systematic demagnetisation by reversals with a decreasing magnetic force which is ultimately reduced to zero. Special apparatus was employed in the tests, which were carried out on strips instead of rings, to avoid the labour of winding the latter. Experiments were made both on iron thus treated, and on virgin iron, which had never been subjected to magnetisation; investigations were also made into the influence of the mode of preparation of the iron upon the results of magnetic tests. Most of the experiments were carried out with small magnetising forces, generally below 10 C.G.S. units. Serious differences were found between the magnetic qualities of strips taken from different parts of the same sheet of transformer iron, showing that valid conclusions cannot be drawn from tests made on a few small specimens.

The discussion was opened by Dr. R. T. Glazebrook, who commented on the practical method adopted by the author for testing iron. Various questions arose as to magnetic leakage at corners, and as to the effectiveness of the clamping, but the results were practically sufficient. He did not think there had previously been so careful an investigation of the previous history effect.

Mr. Campbell referred briefly to the improved permeability of virgin iron, if demagnetised.

Mr. Mordey considered the paper more interesting to physicists than to people using and testing large quantities of iron. However useful the ballistic method of testing transformer iron might be, it required very great care and skill, if accurate results were to be obtained, and it did not give what was especially wanted, *i.e.*, the energy dissipated in the iron. The results obtained were often considerably less than half the true values. He advocated wattmeter methods of testing, and detailed the large losses due to eddies under practical conditions

Owing to the lateness of the hour, Mr. Searle agreed to reply to the discussion in writing.

PHYSICAL SOCIETY.

Proceedings at the meeting held at the Central Technical College, December 9th, 1904, Dr. R. T. Glazebrook, F.R.S., President, in the chair.

Prof. S. P. Thompson read a paper on "A Rapid Method of Approximate Harmonic Analysis." The paper gives a *résumé* of the various methods which have been employed for harmonic analysis by reduction from simultaneous equations, graphical means, and by harmonic analysers. The method adopted by the author is a simplification of a general method of analysis published by Prof. Runge. The half-period of the wave is divided into $2m$ equal parts giving $2m - 1$ equidistant ordinates. These ordinates are then put together in pairs, so that there then may be found the sum and difference of the ordinate of any angle, and the ordinate of its supplement. The sum will contain sine-components only, and the difference cosine-components only. The sums are used for getting out the coefficients of sine-terms and the differences for getting out those of the cosine-terms. The labour of the process varies approximately as the cube of the number of ordinates taken. Using 18 ordinates, the time taken to complete the whole analysis is about 70 minutes; for 12 ordinates it is about 25 minutes, and for six ordinates under two minutes.

Dr. J. A. Fleming said that he had found by experience that most alternating-current curves of current or E.M.F. which occurred in connection with transformer working could be quite nearly represented by a simple sine curve added to the two first odd harmonics having wave-lengths 1/3 and 1/5 of the primary. Hence the analysis of any such curve as the magnetising curve of a current transformer resolved itself simply into the determination of the amplitude and phase difference of these three constituents. They were indebted to Prof. Thompson for bringing before them such a simple arithmetical process of resolution, which reduced the performance of the Fourier analysis of simple periodic curves to little more than mere arithmetic. In addition to the analysis of a single periodic curve, it was useful sometimes to be able to perform the synthesis rapidly, and Dr. Fleming exhibited and described a simple form of instrument which he had designed for effecting this.

Mr. J. Harrison pointed out that the author's system of harmonic analysis could very readily be performed entirely by graphical methods.

A paper on "A High Frequency Alternator" was read by Mr. W. Duddell. The author described and showed in action a high-frequency alternator which he had constructed in 1900 for some experiments on the resistance of the electric arc, and with which frequencies up to 120,000 cycles per second had been obtained. The alternator consists of an inductor, built up out of ferrotype plate, having V-shaped notches cut in its edge so as to have flat-topped teeth. Surrounding the inductor is a laminated ring having two inwardly projecting poles, the air-gap being less than 0·1 mm. The ring is wound so that a direct current flowing round the winding tends to produce lines of force from one pole to the other through the inductor. The number of lines of force varies from a maximum when the teeth of the inductor are opposite the poles, to a minimum when the poles are in front of the spaces. This variation in the total number of lines of force produces alternating E.M.Fs. in any winding either on the pole-pieces or on the ring itself; the movement of the inductor through the distance between two consecutive teeth producing one complete period. One winding on the ring could serve to carry both the direct field current which magnetises the ring and the alternating current produced. In practice, owing to the great importance of any self-induction in the alternate-current circuit, it was found advisable at high frequencies to use separate windings for the two currents. At the highest frequencies the best results were obtained with coils having a few turns of wire fixed right on the tips of the poles. The alternator is driven by means of a figure-of-8 belt drive from two phosphor-bronze disks. Each of these disks is belted to a double-grooved pulley fixed on the shaft of a direct-current driving motor. With this method of drive the inductor was run for several months at speeds between 30,000 and 40,000 r.p.m., and the spindle of the inductor alone could be easily run at 60,000 r.p.m. Using inductors having 30, 60, 90 and 204 teeth, the author obtains small alternating currents having frequencies from a few hundred periods per second up to 120,000 cycles per second. A table is given of all the high-frequency alternators which have come to the author's knowledge, and he would be glad to receive any missing data or data of other machines to include in the table before it is finally printed.

Dr. J. A. Fleming said that, so far as wireless telegraphy was concerned, it was no use to speak of a machine even if it gave this frequency, corresponding to a wave 1½ miles in length, if the output of the machine were only a few watts. If it were 150 H.P. it might be different. The difficulty with most high frequency alternators was the magnetic leakage. Dr. Fleming then described some of the devices adopted by Tesla for obviating this defect.

Prof. W. E. Ayrton gave an "Exhibition of Experiments to Show the Retardation of the Signalling Current on 3,500 Miles of the Pacific Cable between Vancouver and Fanning Island." The experiments were performed upon a cable electrically equivalent to the portion of the Pacific cable between Vancouver and Fanning Island, the product of the capacity (in mfd.) and the resistance (in ohms) being nine millions. Three dead-beat galvanometers were employed to indicate the current at the beginning, in the middle, and at the end of the cable. It was shown that upon applying an E.M.F. at one end of the cable the current at that end was enormously greater than its steady value, and that one-fifth of a second elapsed before any indications of current were shown at the far end of the cable. By that time the current at the sending end was 3·7 times its steady value, and after two-fifths of a second it had fallen to 2·3 times its steady value. In about 5 seconds the current became steady.

ELECTRIC RAILWAYS IN GERMANY.

The first conference between Herr von Budde, Minister for Railways, and representatives of the Allgemeine Elektricitäts Ges. and the Siemens & Halske A.-G., together with the principals of the Study Co. for Express Electric Railways, has taken place at the Ministry of Public Works, Berlin, in connection with the scheme for the construction of an electric railway between Berlin and Hamburg. That the proceedings were merely of a preliminary character is shown by the absence of technical representatives of the supervising authorities and the State Railway Administration, whose views on the question will naturally have to be taken into consideration before the high speed electric railway project makes any advance, particularly in regard to the introduction of the line right into the main stations of Berlin and Hamburg, and the provision of a special track or permanent way for the railway. The results of the high speed trials on the Marienfeld—Zossen Railway were placed before the conference, and general questions discussed; but, beyond this, nothing further was done, and the proceedings terminated with the belief on the part of the promoters that the scheme has advanced a stage, and that further conferences on the subject will take place. In the meantime, the fact may be recalled that, according to the plans which have been prepared, a single track railway, with a

speed of 100 miles an hour, is estimated to cost £3,500,000, and £5,250,000 with a double track, while the expenditure for a higher rate of speed is calculated at £7,000,000. As it is improbable that a speed greater than 100 miles an hour will be aimed at in the event of the scheme being proceeded with, this would allow of the journey between Berlin and Hamburg being covered in 1 hour and 47 minutes. If, however, the speed of the present express trains were increased to 72 miles an hour—as has been the case, experimentally, at all events, on certain steam railways in Germany during the past year and a half—the time saving likely to be effected by the introduction of electric traction would only be 36 minutes. The main question for the moment is the financial promotion of the projected railway. It seems almost certain that the State will not provide the necessary capital. It will apparently have to be raised by subscription if the construction of the railway is sanctioned, and the promoters would probably seek to obtain a Government guarantee of interest payments, but this would be a very difficult question to solve, as the suggested electric line would divert passenger traffic from the existing State railway, if travellers were willing to pay fares of from two to three times the present charges.

The scheme for the construction, in Berlin, of an electric railway on the Langen suspended system, as in operation between Barmen and Elberfeld, has engaged the attention of the various local and other authorities for a long time past, but it does not appear to make any progress. It is assumed that the State Railway authorities are not opposed to the project, as the Berlin railway administration has been authorised by the Railway Ministry to enter into negotiations with the promoter of the railway—the Continental Co. for Electrical Enterprises—in regard to the method of crossing over the State lines, and to place the necessary facilities at the company's disposal to enable it to work out the special scheme. As against this attitude may be contrasted the action of the local police authorities, who have raised various objections to the proposed suspended railway, while the principal obstacle in the way still remains to be surmounted, namely, the possession of the consent of the Municipal Council, whose Highways Committee requires the company to construct an experimental section of the suspended railway in order to form an opinion as to its architectural effect in Berlin, although it has inspected the working of the Barmen—Elberfeld line, and been able to judge as to its general appearance. Nevertheless, the Committee will not bind the Council in the matter of the trial length; and as the company is indisposed to embark upon the large expenditure without any guarantee, the position of affairs may be described as representing a deadlock. It is understood that the Royal Commission on London Traffic has either paid a visit, or intends to do so, to the Barmen—Elberfeld line, as a plan for the construction of a similar type of railway has been placed before the Commission as being applicable to London.

The Berlin magistrate has forwarded to the police supervising authorities for approval details of the new scheme which has been prepared for the establishment of municipal underground electric railways in that city. The first proposes the construction of a line between the north and the south of the city; the second, an extension of the first through Wilmersdorf to Schmargendorf; the third, a line crossing the town between the east and the west, or between Rixdorf and Moabit; and the fourth, a large circle railway in the north-east. In addition to these proposals, the communal authorities of Wilmersdorf, Schmargendorf, Dahlem and Zehlendorf have had prepared a detailed scheme for the construction of a high-speed electric railway to serve these localities. The length of the railway, which would be provided with 14 stations, is over 7 miles. The estimated cost for construction and equipment exceeds £1,200,000, and in addition to this it is estimated that a further sum of £800,000 would be required as a subsidy to enable the undertaking to pay its way until 1918, when it would be self-supporting. It is expected that all the schemes engaging attention in Berlin at the present time will soon receive the consideration of the competent authorities, with the object of deciding which are necessary in the interests of the travelling public.

ELECTRICAL IMPORTS OF THE UNITED KINGDOM IN RELATION TO INTERNAL TRADE.

By W. POLLARD DIGBY, F.S.S.

The energetic pamphleteering of Mr. Gustav Byng, the Cassandra-like utterances of the Protectionist Press whenever a foreign firm supplies plant to a British municipality, together with quotations from the import statistics of the trade and navigation returns of the United Kingdom, have conveyed to a great number of those interested in electrical engineering the fear that the glory of England as a manufacturing nation is well symbolised by comparing it to the extinguished centres of commerce which at one time flourished at Carthage, Babylon, Alexandria or Venice. The writer believes that this fear is, in a large measure, groundless, and he may, for controversial purposes, cite not only the world-wide repute of the goods produced, but the excellent dividends and splendid reserve fund which stand to the credit of the firm with which Mr. Byng (who was a consistent Protectionist before an eminent statesman took that cause under his wing) is so prominently associated. Ten per cent. dividends are no evidence of ruin. The taunt which has been levelled against the Tariff Commission and the League generally, that it is a gathering of unsuccessful manufacturers, does not apply to the actual Protectionist advocates among electrical manufacturers. Neither Mr. Byng, who is chairman of one branch of the League, nor Mr. George Flett (of Messrs. Dick, Kerr & Co., Ltd.), who is one of the Commissioners, can in any way be regarded as broken-down manufacturers. After all, as Mr. Alexander Siemens said in May last, the personal equation is an important one. "There were people in every industry who would go to a business, and in six months would turn a profit-bearing business into a losing concern." The most sweeping form of Protection which could be devised is not fool-proof, and whatever may be its demerits, Free Trade gives a fair field to the conflicting interests of varied manufactures, and does not artificially foster any particular class of incompetents or monopolists at the expense of the community.

In all fiscal controversies undue and injudicious confidence has been placed on import and export figures. One of the past presidents of the Institution of Electrical Engineers, who held office between Mr. Siemens's previous and present terms, in a letter to the writer, said :—"I am very glad you are pointing out the absurdity of estimating the country's prosperity by the external trade. If the country does an internal trade of 1,000, and an external trade of 10 one year, and an internal trade of 10,000 coupled with an external trade of five the next year, all the newspapers lament the national calamity, and recommend that we should throttle the five by tariffs as soon as possible."

It is the object of the writer first to narrate the British electrical imports and their sources, and then to contrast their volume with certain figures which are a fair index (while not an absolute measure) of the tremendous electrical industry of the country.

Imports of electrical goods and apparatus into the United Kingdom have only been separately enumerated according to their countries since 1900. "Electrical Machinery" was reckoned as "Machinery and Mill work, not Steam Engines" until 1903.

TABLE I.

Country.	1900.	1901.	1902.	1903.	Electrical Machinery 1903.
United States	£832,801	£388,181	£159 601	£125,721	£305,653
Germany ...	86,951	74,214	81,759	119 044	119,525
Holland ..	115,016	149,014	162,965	187,946	23,178
France ...	140,055	123,927	160,115	137,942	36,553
Belgium ...	76,712	87,242	104 635	124,262	53,746
Sweden ...	9,155	17,712	13,225	115,400	—
Other foreign countries and British possessions	3,615	6,076	5,039	8,714	15,988
Total ...	£1,265 946	£849,257	£687,514	£819,029	£554,643

Imports of a telegraphic nature were also first computed separately in 1903 as "Telegraph Cables and Apparatus." Prior to this year they were included under "Electrical Goods and Apparatus." Their source, in 1903, was as follows :—

Germany	£4,048
Holland	11,959
Belgium	16,424
France	20,987
Other foreign countries	4,032
	£57,360

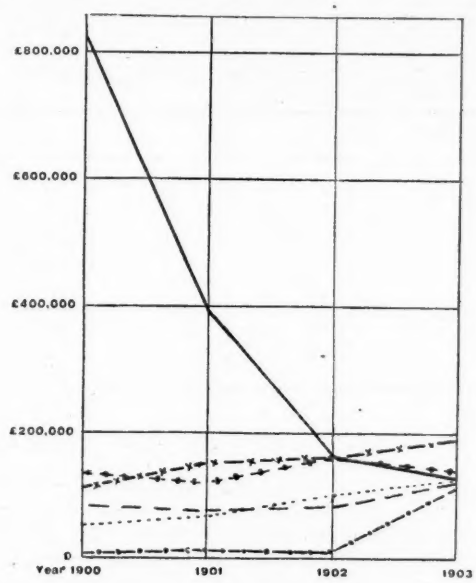
Although the detailed statement of imports of "Electrical Goods and Apparatus," did not distinguish their sources before 1903, the Statistical Abstracts of the United Kingdom mention certain electrical imports under the heading of "Electrical Wares and Apparatus" as far back as 1897. In Table II. these, and the previously narrated figures, are contrasted with the aggregate subscribed capital invested in electrical manufacturing concerns.

TABLE II.

Year ending December 31st.	Aggregate subscribed capital according to Mr. Garcke.	Imports of electrical goods (or wares) and apparatus.	Ratio of imports (*b*) per £100 of subscribed capital.
	(*a*)	(*b*)	£
1897	8,519,430	242,185	2 84
1898	10,535,937	367 572	3 48
1899	16,799,152	613.593	3 65
1900	21,708,180	1,265,946	5 83
1901	25,990,606	849.257	3 27
1902	29,852,575	687,514	2 30
1903	35,768,001	876,389*	2·45

*Imports of telegraph cables and apparatus included for purposes of comparison only.

Surely, the foregoing figures indicate anything but a doomed industry. The imports of electrical goods and apparatus from the United States have fallen tremendously. This, of course, is due to certain large trans-Atlantic firms having established branches in England and erected large



Curve A.

Imports of Electrical Goods and Apparatus into the United Kingdom from Various Sources.

From United States .. ——— From Germany .. — — —
„ Holland .. .. —X—X— „ France .. -●- -●-
„ Belgium .. .. ----- „ Sweden .. —·—·—

works near Manchester and Rugby. It is a singular commentary on our much belittled fiscal system that these two undertakings should have established subsidiary companies with a total paid-up capital of over £3,000,000 sterling, in a country whose manufacturing supremacy was declared to be in a parlous condition. Surely, if the Protectionists were right, these mammoth American undertakings would have continued their system of manufacturing at Pittsburg and Schenectady, and, immune behind their own tariff walls, continued sending their products to the "dumping ground of the world."

Of the imports of "Electrical Goods and Apparatus" coming direct from Germany, the value imported in 1903 was only £22,000 greater than in 1900. The imports from Holland and Belgium have risen very greatly, and it is exceedingly probable that certain German produce has come *viâ* Dutch or Belgian ports. The rise of Swedish imports in 1903 is rather curious.

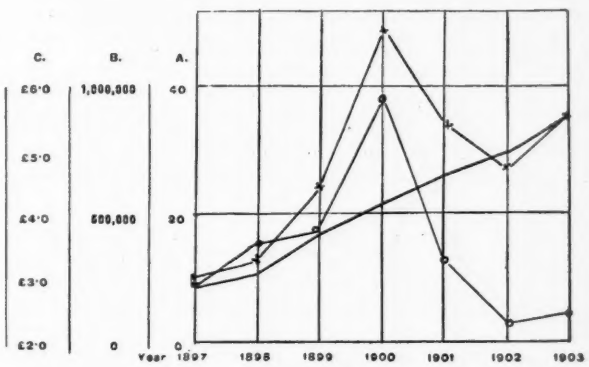
An examination of Table II. shows that up to the present the history of British electrical imports may be divided into two stages. In the first, from 1897 to 1900, the imports increased in a greater ratio than did the capital invested in manufactures. From 1900 the capital continued to increase while the imports declined. The net result is, that although the imports in this particular classification are nearly four-fo'd what they were in 1897 (and would thus afford a splendid "illustration" for Protectionist propaganda), the capital invested has, despite a costly war, increased at a greater rate.

It is to be regretted that "Electrical Machinery" was not separately computed before 1903; a similar series of percentages cannot, therefore, be calculated.

In a preceding article the writer has shown that British manufacturers export certain electrical goods under three main headings, and that these exports bear only a very small ratio to the capital invested in the manufacturing firms of the country.

The writer now proposes to estimate the value of part of the home market. To do this in its entirety is practically impossible. Thanks, however, to the capitalistic side of Mr. Garcke's *Manual*, some important figures are available. Varied indeed are the products of the large electrical firms. The Government purchases instruments and materials for telegraph and telephone lines. Municipal telephony is trying to secure a foothold. The submarine telegraph companies demand special cables. The cable companies have to supply extra-high, high, and low tension feeders, distributing mains, and service mains. Dynamos and alternators are built for central stations; motors and transformers are required everywhere. Arc and incandescent lamps, an infinite variety of fittings, primary and secondary batteries, and instruments of all kinds are needed. Electric traction is now opening up a very wide field.

It would probably be a heavy task for a Commission of engineers and manufacturers to enumerate the financial volume of all of these. It is, however, moderately easy to



Curve B.

Relation between Imports of Electrical Goods and Appliances, and Capital Invested in Manufacturing Concerns.

A. Total capital invested in electrical manufactures. (Scale £.0,000,000 to the inch) .. .. ———
B. Imports of electrical goods and apparatus. (Scale £500,000 to the inch) .. .. —X—
C. Ratio of imports to each £100 of manufacturers' capital .. —●—

compute the increase in capital in each of the seven years covered by our preceding tables, and to contrast the increase of the capital of certain groups of purchasers with the imports, and with the increase of manufacturers' capital.

Table III. shows that not only have the imports of electrical goods failed to retain the position they once held in regard to the capital invested in manufacturing concerns, but, further, that they (the imports of electrical goods) have failed to maintain their position in relation to the aggregate annual increases of capital invested under the five headings given above, and finally have now fallen to the low ratio of £2·63 per £100 increase of capital invested in the consuming directions. It is, of course, necessary for the continuance of a prosperous internal trade that it should increase at a greater rate than does the capital invested in the manufacturing concerns for which it caters.

Unfortunately, imports of electrical goods do not wholly account for all imports. It has been explained that "Electrical Machinery" was only enumerated as such last year. We can, therefore, compare it directly with the figures for 1903 only. In relation to the increase in capital invested in the five groups of purchasing companies, these imports are only £1·65 per £100 of capital. Even adding them to the imports of electrical goods, *the ratio of all electrical imports to the year's increase of capital invested in non-manufacturing electrical concerns is only £4·28 per £100.*

TABLE III.—*Annual Increase in Capital Invested in Electrical Purchasing Concerns, in relation to Imports and to Capital Invested in Electrical Manufactures*

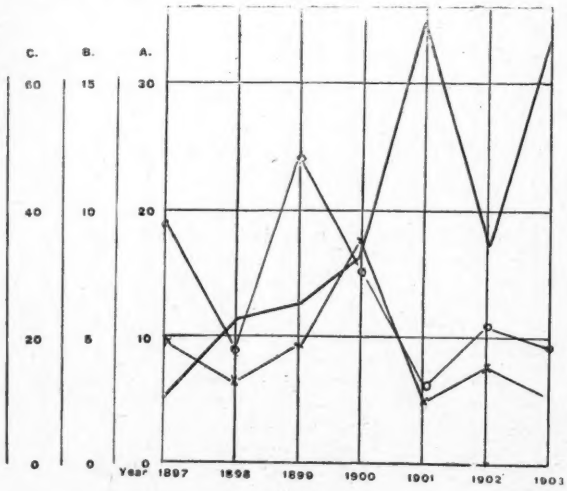
Year ending December 31st.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	£	£	£	£	£	£	£
Telegraph companies ...	169,421 (+)	710,590 (+)	2,201,592 (+)	*2,499,983 (−)	*1,120 612 (+)	*12,481 (−)	695,674 (+)
Telephone companies ...	550 (+)	675,839 (+)	570,259 (+)	1,245,397 (+)	346,847 (+)	537,322 (+)	3.0,49. (+)
Municipal telephones ...	—	—	—	—	103,450 (+)	150 250 (+)	64.804 (+)
Electricity supply	2,359,036 (+)	3,985,457 (+)	3.655,394 (+)	8,414,239 (+)	11,508,685 (+)	7,274,724 (+)	7,258,195 (+)
Electric traction	2,468,502 (+)	5,852,973 (+)	6,402,819 (+)	8,089,773 (+)	21,143,994 (+)	9,669,489 (+)	24,191,065 (+)
Total net increase in subscribed capital in year.	4 997,509	11,224,859	12,830,063	16,258,427	35,223,588	17,619,304	33,270,230
Ratio of increase of capital invested during year in electrical manufacturing undertakings per £100 increase in subscribed capital in industries mentioned above. £	38·9	17·9	48·8	30·1	12·1	21 9	18 6
Ratio of imports of electrical goods and apparatus per £100 increase of subscribed capital in industries mentioned above during year. £	4 84	3·27	4·78	7 78	2·41	3·91	2 63

* The decrease is due to amalgamations, and also to redemption of debentures.

TABLE IV.—*Relation between Increase of Lamps Connected and Imports of Electrical Goods, Capital Invested in Manufacturing Concerns and Capital Invested in Supply Undertakings*

Year ending December 31st	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Number of lamps connected	2,949,300	4,106,727	5,659,883	7 660,388	10,436,019	12,85 ,7	17,059 064
Increase in number of lamps connected	917,911	1,157,418	1,553,156	1,000,595	2,775,631	2,423 702	5,199,343
Ratio of increase in number of lamps connected to each £100 value of imports of electrical goods	379	315	253	79	326	354	593
Ratio of increase in number of lamps connected to each £100 of capital invested in electrical manufacturing concerns	10·7	11·0	9·2	4 9	10·7	8 1	14 5
Ratio of increase in number of lamps connected to each £100 of total capital invested in electricity supply undertakings	9·0	8·2	8·7	3·8	7·4	5 4	9 9

In a comparison of the above character, factors favourable to the propaganda of both schools of fiscal economists are necessarily omitted. It must not for a moment be supposed that the writer regards the comparison put forward as a final one in the sense that it is all-embracing. Mr. Garcke's *Manual* takes cognisance only of the authorised loans, or subscribed capital of limited liability undertakings whose works are mainly electrical. A large number of private firms who are not registered under the Companies' Acts are excluded, as also the capital expenditure on Post Office telegraphs and telephones.



CURVE C.

RELATION BETWEEN IMPORTS OF ELECTRICAL GOODS, INCREASE OF CAPITAL INVESTED IN CERTAIN PURCHASING CONCERNS, AND INCREASE OF ELECTRICAL MANUFACTURERS' CAPITAL.

A. Purchasers' increase of capital in Telegraph and Telephone Co.'s electricity supply and traction undertakings .. .. ——————

B. Ratio of imports to each £100 increase of purchasers' capital .. .. —x——

C. Ratio of increase of manufacturers' capital to each £100 increase of purchasers' capital .. .. ——•—

On the other hand, it must not be supposed that all the capital invested under the five headings finds its way to the pockets of the manufacturers themselves. In addition to purchasing generators, cables, switchboards, or instruments for the central station, a local authority or company supplying current for lighting or power purposes has to purchase a site, erect a generating station, and employ labour in cable laying. In regard to tramways, rails are purchased (occasionally from Belgium), trolley wire, poles, brackets are needed; labour has to be paid for, as well as the expenses of securing a provisional order.

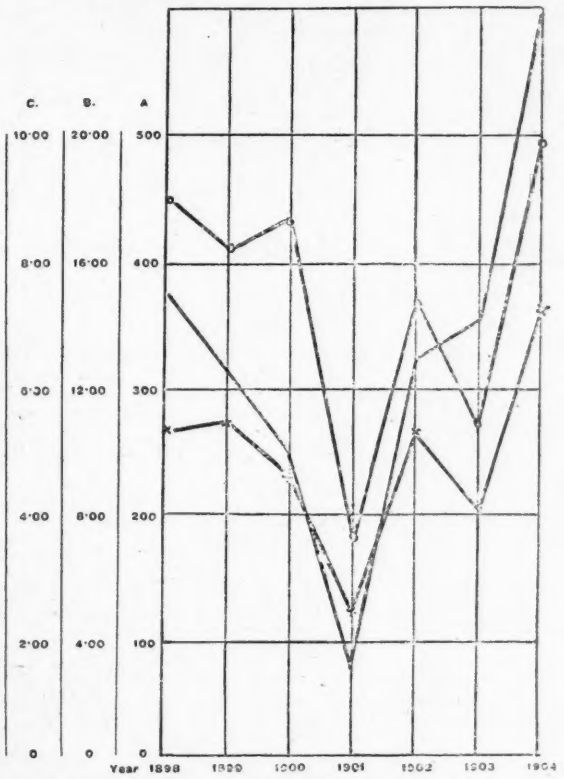
Yet again there has been a large expenditure on isolated plants for power for factories and for house and factory lighting. This contributes to a swelling of the manufacturers' sales. No record is available of this demand. Further, certain engineering firms connected with the shipbuilding and marine engine building industries have established electrical departments. Other ship builders buy their ship lighting sets directly from electrical engineering firms.

So far as internal electrical developments go, we have an index of the activity of electricity supply in the shape of tables giving the units sold during any individual year, or the lamps connected at the end of the year in their 8-C.P. equivalent. It may, therefore, be of interest to study the relation which the lamps connected bear, both to the imports of electrical goods, and to the aggregate capital interested in electrical manufactures, and in electricity supply undertakings.

Table IV. shows clearly that whereas the number of lamp connections per £100 value of imports fell alarmingly until 1900, the three succeeding years showed a rise in lamp connections out of all proportion to the imports of "electrical goods." If, therefore, we consider momentarily that our imports under this classification were entirely confined to glow lamps and fittings used in house wiring—which they are not—for each £100 value of electrical goods imported in 1903, nearly £300 was spent on fittings and the attendant

material, reckoning that each "point" connected only occasioned the low expenditure of 10s. for material. Such a comparison may only be cited in passing as evidencing that no matter how our imports of this nature are considered in relation to our internal activity, it is apparent that they only occupy a relatively small position, and one receding from the importance they possessed in 1900.

The last two lines in Table IV. merely serve to show that the equivalent number of 8-c.p. lamps connected fell both in regard to the capital invested in manufacturing concerns, and also in regard to the capital invested in supply undertakings until 1900; after this date the growing demands of the consumers tended again to resume their old proportion to the capital invested.



Curve D.

Lamp Connections (In 8-c.p. Equivalent) in Relation to Imports of Electrical Goods and Apparatus to Manufacturers' Capital, and Capital Invested in Supply Undertakings.

A. Ratio of lamps connected per £100 value of imports ——
B. Ratio increase of lamps connected per £100 increase of manufacturers' capital —x—
C. Ratio increase of lamps connected per £100 increase of capital invested in electricity supply undertakings —o—

A last word may perhaps be given, not to a further recitation of the diminutive character of the catalogued imports when compared with internal activity, but to a protest concerning the manner in which not only these imports, but also our electrical exports, are reckoned. The introduction of new classifications into the Board of Trade Returns for 1903 of "Electrical Machinery" and "Telegraph Cables and Apparatus" was undoubtedly a step in the right direction. Surely the Electrical Section of the London Chamber of Commerce might memorialise Sir Alfred Bateman to ask for the introduction of a rather more extended list of headings under which electrical goods imported or exported may be classed. Germany sets a very good example by providing the following classifications:—(379A) Electrical glow lamps; (475) electrical machinery; (516A) electrical cables; and (525) telegraph and telephone apparatus. This division is capable of improvement, but it is to be preferred to that which is available in the United Kingdom.

Spain.—Work has just been commenced on the conversion of the tramway between Barcelona and Sarria into an electric line.

SIMPLE STORIES.

By "INNOCENS."

XIII.—The Two Cults.

There flourished in a certain station an engineer who was a Man of Culchaw, for he was of the House of Loughborough and of the seed of Finsbury. His attainments were exceeding great, so that the Chief himself did in secret tremble at them, for he manipulated the Kelvin balance even as the potter mouldeth the clay, and he babbled of differential calculus in the night watches.

Now there came unto that station another engineer who was of the seed of Amalek and the House of Cunard, and he understood not the theory of electricity, nor the ways of the Finsbury man, neither did he care much. For he did engross himself in the mechanical side, and did let the electrical part rip. And there was peace and quietness in that station of the deadly sort.

For behold, each engineer had come unto that station to gain experience, and verily, neither of them said so, forasmuch as they were not in the habit of giving themselves away. But they watched each other, even as cat observeth cat upon the garden-wall. And as they watched, behold, each thought that the other was doing him. For verily, the electrical man did find the mechanical man Meggering a starting switch, and the mechanical man observed the electrical man sneak the boiler suit that appertained unto him of Cunard, and crawl into an economiser. So that the mechanical man said within himself, "This man seeketh a leaky tube that he may report it," and the electrical man said, "Lo, this bounder tryeth to find a bad insulator that he may pose as an electrician."

Wherefore the resources of diplomacy were much taxed between these twain, and the workmen, being given to observation on their own account, did greatly rejoice thereat, and did fan the flame in their most innocent manner. For they perceived that there would be no discipline.

It came to pass, therefore, that on a certain day there was a difference of opinion, and on the next day there was an argument, and on the third day there was a ruction. For the electrical man did order a greaser to burn some dirty waste which the mechanical man was keeping to clean the stoker gear with. And the mechanical man exploded thereat, saying, "Why orderest thou this man to do this thing? Knowest thou not that economy is sometimes of service in an electric light station?" And the electrical man made answer, "Go thou to Jericho, for I will do as I please." But the mechanical man said, "Not so, for I have been unto Joppa, and lo, the engine room of a boat in the Red Sea is hotter than thou hast dreamed of, even in thy little experience. But if thou likest not my ways, nor understandest my methods, go thou even unto the hottest place of them all."

And the electrical man said, "Not so, for my time is not yet come. Yet, peradventure, we shall meet each other again in another sphere, and lo, I will be thy stoker."

And the mechanical man was very wrath, and did foam at the mouth, and did make reference unto Gunga Din, whose history, is it not written in the book of Kipling? Neither was the electrical man backward, for he did refer most unkindly to the Board of Trade certificate for chief engineers.

Now the sound of this row did reach unto the ears of the Chief, and he made haste to come down, saying, "What meaneth this devilment?" and they both began to speak at once, so that the Chief tore his hair, saying, "Ye are too loud! Ye are too loud! Speak ye simply unto me, that I may hear, and judge between ye."

And they did recount unto him their woes, and did make a pretty tale of them.

When, therefore, the Chief had heard them patiently, he did chuckle, and said unto them, "Take ye a cooling lotion!" And he gave them each a cooling lotion.

Then said he unto them, "Ye mugs! Ye marvellous mugs! Know ye not that by my will, and by that only, ye keep your places? Who art thou, O electrical man, to judge thy mechanical brother? And who art thou, O Board of Trade engineer, to rave at thy Finsbury mate? It is I

who engage, and it is I who sack. If either of ye please me not, then be sure that I will hoof you out. If ye impress me with your virtues, it is I who will advance you. Ye are both necessary unto me, though ye are both imperfect. And verily my jobs shall go unto the best man, to him who hath the most common sense, even to command the respect of his men. Go ye therefore unto your duties, and behave like men, for verily I will judge by works, and not by words, and there shall be peace in my station."

And the engineers were ashamed, and went forth unto their labours in amity; and verily there was discipline in that station.

Moral: When pot calls kettle black, there is much soot in the atmosphere.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"ENQUIRER" writes:—"I shall be glad to receive a little information *re* so-called 'free' or assisted wiring.

"1. Is it necessary in order to undertake free wiring to have a free wiring clause inserted in our provisional order (1893)?

"Judging from the recent action against the Barnstaple Council, I take it that no public body can legally undertake 'free' wiring if a clause to that effect is absent from their order.

"2. Can you give me the approximate cost to get 'free' wiring clause inserted in our order?"

*** It seems to be clear from the case referred to by "Enquirer" (A. G. *v.* Mayor of Barnstaple, the ELECTRICAL REVIEW, May 8th, 1903, p. 771) that a local authority cannot enter into free wiring agreements unless so authorised by its provisional order. Since 1899, free wiring, in which phrase are included arrangements for prepayment by way of rent or by instalments spread over a number of years, purchase on the hire system, &c., has become very common, and is to be met with where electrical energy for lighting purposes is afforded by local authorities as well as by companies. A special free wiring clause must be inserted. It is conceived that a clause similar to that which appeared in the Halifax Corporation Act, 1898 (61 and 62 Vict., ch. cxlvi) Sec. 35, would suffice. There the corporation was authorised "To purchase, hire, sell, let on hire or otherwise deal with dynamos, electric motors, accumulators, meters, burners, arc and other lamps, fittings, wires, plant, engines, conductors, machinery, apparatus and appliances for, or in relation to, the production, supply, distribution, or utilisation of electricity, or required or used for or in connection with their electrical works and undertaking."

It is not within our power to give any approximate estimate of the cost of obtaining the insertion of this clause.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

26,391. "Improvements in mechanism for use in conjunction with apparatus for utilising electro-magnetic or 'Hertzian' waves." M. H. SMITH. December 5th.

26,445. "Improvements in brushes for electric machines." V. I. FEENY. (C. Wirt, United States.) December 5th.

26,446. "Improvements in and relating to electrical rheostats or resistances." V. I. FEENY. (C. Wirt, United States.) December 5th.

26,449. "Improvements in and relating to insulator for electric wires." S. B. FLYNT and L. A. MAIDEN. December 5th. (Complete.)

26,475. "Improvements in electric fire alarms and thermo-indicators." A. H. MCNEIL. December 5th.

26,527. "Improvements in electric ignition apparatus." A. ECKSTEIN and H. J. COATES. December 6th.

26,529. "Improvements in or relating to electric storage batteries." R. J. CROWLEY and A. BLACKMAN. December 6th.

26,538. "Improvements in electrical fuse boxes, ceiling boxes, wall plugs, and the like." F. HERBERT. December 6th. (Complete.)

26,552. "Improvements in lanterns for use in lighting by electricity or gas." S. BIHELLER. December 6th.

26,557. "Improved process and apparatus for the production of metals of the alkali group by electrolysis." A. J. BOULT (E. A. Ashcroft, Algeria.) December 6th.

26,582. "Improvements in direct current dynamo-electric machines." C. E. DAVIES. December 6th.

26,588 "Improvements in systems of electrical distribution." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) December 6th.

26,589. "Improvements in, and relating to, electric switches." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) December 6th.

26,602. "Improvements in, and apparatus for, the production of reactions in gases by means of electric arcs." J. Y. JOHNSON (Badische Anilin and Soda Fabrik, Germany.) December 6th. (Complete.)

26,603. "Improvements in, and apparatus for, forming devices for holding or suspending overhead electric conductors, or trolley wires, and the like." I. E. WINSLOW. December 6th.

26,618. "Improvements in, and relating to, appliances for shifting the points of electric and other tramways or railways." A. TAYLOR. December 7th.

26,686. "Improvements in electric telegraphs." SIEMENS BROS. & CO., LTD., and G. S. GRIMSTON. December 7th.

26,696. "Improvements in and relating to apparatus for wireless telegraphy or telephony." S. EISENSTEIN. December 7th. (Complete.)

26,699. "Improvements in motor-controlling systems." A. C. EASTWOOD. December 7th. (Complete.)

26,704. "Improvements in clips for supporting electricity conductors or wires." A. R. WALMSLEY. December 8th.

26,708. "Improvements in and relating to automatic starters for electric motors." C. W. WEBSTER. December 8th.

26,709. "Improvements in and relating to fuse or terminal boxes for use in electrical mains or the like." A. S. BLACKMAN. December 8th.

26,748. "Improvements in apparatus for controlling telegraphic recorders and other instruments" MARCONI'S WIRELESS TELEGRAPH CO., LTD., and E. PRIDDLE. December 8th.

26,757. "Improvements in signalling bells worked by electrically-controlled compressed air or other gas." SIEMENS BROS. & CO., LTD. (Siemens & Halske Actien-Gesellschaft, Germany.) December 8th. (Complete.)

26,671. "Improvements in and relating to electric arc lamps." J. M. WELLINGTON and W. F. DANIELL. December 8th.

26,769. "Improved coil trembler for electrical ignition apparatus of high speed engines for motor-cars and similar vehicles." S. J. WILLIAMS. December 8th.

26,772. "Improvements in and relating to electro-magnetic apparatus." H. H. LAKE. (C. J. Schwarze and A. M. Kells, United States.) December 8th. (Complete.)

26,786 "Improved means for rendering the insulation of electrical conductors fire-proof." G. G. M. HARDINGHAM. (Felten & Guilleaume Carlswerk Act.-Ges., Germany.) December 8th.

26,791. "Improvements in connections for compounding transformers and like apparatus." A. HEYLAND. (Date applied for under Patents Act, 1901, December 8th, 1903, being date of application in Belgium.) December 8th. (Complete.)

26,799. "Improvements in holders for electric incandescent lamps." J. C. DEAR. December 8th.

26,805. "A new or improved alternating current electro-motor." F. M. LEWIS. December 8th.

26,820. "Improvements in electrical switches and cut-outs." C. M. DORMAN, R. A. SMITH and H. G. BAGGS. December 9th. (Complete.)

26,849. "Improved apparatus for electro-deposition of metals." B. M. BAILEY. December 9th.

26,906. "Improvements in or connected with electric demand indicators." J. R. DICK and THE REASON MANUFACTURING CO., LTD. December 9th.

26,915. "Improvements in electrodes for arc lamps." J. T. H. DEMPSTER. (Date applied for under Patents Act, 1901, December 10th, 1903, being date of application in United States.) December 9th. (Complete.)

26,916. "Improvements in arc lamp electrodes." C. P. STEINMETZ. (Date applied for under Patents Act, 1901, December 10th, 1903, being date of application in United States.) December 9th. (Complete.)

26,917. Improvements in electrodes for arc lamps." W. R. WHITNEY. (Date applied for under Patents Act, 1901. December 10th, 1903, being date of application in United States.) December 9th. (Complete.)

26,918. "Improvements in arc lamps and electrodes therefor." J. HARDEN. (Date applied for under Patents Act, 1901, December 10th, 1903, being date of application in United States.) December 9th. (Complete.)

26,919. "Improvements in arc light electrodes." J. HARDEN. (Date applied for under Patents Act, 1901. December 10th, 1903, being date of application in United States.) December 9th. (Complete.)

26,920. "Improvements in arc light electrodes and methods of making the same." C. F. LINDSAY. (Date applied for under Patents Act, 1901, December 10th, 1903, being date of application in United States.) December 9th. (Complete.)

26,941. "Improvements in electrodes for arc lamps and method of making the same." W. S. WEEDON. December 9th. (Date applied for under Patents Act, 1901, December 10th, 1903, being date of application in United States.) (Complete.)

26,922. "Improvements in arc light electrodes." W. S. WEEDON. December 9th. (Date applied for under Patents Act, 1901, December 10th, 1903, being date of application in United States.) (Complete.)

26,923. "Improvements in and relating to electric rheostats." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) December 9th.

26,925. "Improvements in electrical measuring instruments." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) December 9th.

26,955. "Improvements in and relating to electrical switches." G. PAGE, A. HOLMES, J. H HOLMES, L. W. HOLMES and E. HOLMES. December 10th.

26,956. "Improvements in and relating to electrically controlled and variable speed gear." H. V. JAMES and R. A. MARPLES. December 10th.

26,997. "Improvements in or relating to telephone apparatus." W. M. STILL and A. G. ADAMSON. December 10th.

27,000. "Improvements in and relating to electro-magnets." D. L. LINDQUIST. December 10th. (Complete.)

27,003. "Improvements in electric switches." A. BENASSY. (Date applied for under Patents Act, 1901, December 17th, 1903, being date of application in Switzerland.) December 10th. (Complete.)

27,010. "Improvements in frequency changers." O. O KRUH. (Date applied for under Patents Act, 1901. December 12th, 1903, being date of application in United States.) December 10th. (Complete)

27,011. "Improvements in vapour electric apparatus." O. O. KRUH. (Date applied for under Patents Act 1901, December 12th, 1903, being date of application in United States.) December 10th. (Complete.)

26,957. "Improvements in signalling on electric tramways and railways. C. H. PYM and E. J. WITCOMBE. December 10th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

ELECTRIC FUSES FOR BLASTING PURPOSES. Curtis & Harvey, Ltd., and T. Malson. 26. January 1st.

ELECTRICALLY-TRANSMITTING, RECEIVING AND CHECKING SIGNALS, ORDERS AND THE LIKE. M. Barbara. 124. January 2nd.

MEANS FOR SECURING WIRES ON INSULATORS. F. Benedikt, jun., and J. Macek. 461. January 7th.

MEANS OF CONNECTION BETWEEN BRUSH HOLDERS AND PILLARS OF DYNAMO-ELECTRIC MACHINES AND ELECTRIC MOTORS. E. S. G. Rees. 571. January 9th.